A CONFIGURATIONAL ANALYSIS OF PARENTAL INVOLVEMENT IN PRIMARY SCHOOL MATHEMATICS

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Abstract

I use the method Qualitative Comparative Analysis (QCA) to analyse data from the British Birth Cohort Study of 1970 which follows a cohort of children born in a particular week in 1970. QCA allows for case-based analysis on large datasets. The solutions from a QCA analysis can be thought of as causal pathways to a specified outcome showing that causal factors do not necessarily operate in a homogeneous way across all cases – a key assumption of regression-type analyses. Initially, I conduct some QCA analyses on the BCS and explain, in detail, the various stages of the process. Included in this explanation is a detailed, methodological discussion about some of the difficulties. Particularly, I discuss how to proceed when faced with limited diversity in the data – a not-uncommon problem in social data which is often overlooked. One of the intermediary steps in a QCA analysis is the creation of a truth table which has a row for each possible combination of causal factors and details the number of cases in each row and how many of these achieve the outcome. Each of these rows can be thought of as a type – a particular configuration of factors. A large dataset such as the BCS will suffer from a lack of detail in some areas and, it is for this reason, that I also conducted interviews. Those interviewed were selected to represent some of the types I wanted to explore in more detail. I investigated what different strategies were employed by parents who would come under the same type(s) in the QCA analyses. Specifically, I examined in what way these differing strategies were linked to possession of differing amounts and types of cultural and social capital, as conceptualised by Bourdieu, in the parents. I suggested in this section that the composition of capital must be explored as well as the individual levels of particular types of capital as this helps us understand how parents transfer (or fail to transfer) their capital to their children. The combination of QCA and interview analysis allowed me to take a case-focused, configurational approach to the investigation of parental involvement in mathematics education. An approach such as this sees the parents (and their children) as products of a collection of circumstances which may combine to produce particular disadvantage or foster an unpredictable approach to overcoming disadvantage.

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Introduction – The Rationale for and Structure of The Study

Background

As an undergraduate mathematician, I remember being told by friends in other subjects how useless they were at mathematics. Enquiring further, I realised that many of my university friends had only studied mathematics to GSCE level despite having high academic aspirations overall. I thought back to my own experience of mathematics at school and tried to imagine to whom I might have turned to if I was struggling.

My parents were encouraging and attentive but, by the time I reached the upper end of secondary school, I was covering concepts and subjects that they had not. In primary school, I rarely felt the need to ask for their help but I remember well that other classmates had parents who almost did the work for them.

Thus, my first port of call would probably have been my teacher but, failing that, I would sit and work through a problem independently. This certainly was not the case for some of my classmates at secondary school as they had parents who were teachers, or knew teachers, or parents with a great deal of mathematical confidence.

It became apparent to me that ‘help from parents in mathematics’ was a far more complex matter than it first appeared. For me, as a child who rarely struggled with school mathematics, it may not have made much difference to my attainment. For others who did struggle, the practical input of a parent could feasibly raise their achievement levels.

I wondered, then, in which cases was parental involvement enough to make a difference to mathematics attainment and in which cases did it make no difference. As mentioned above, characteristics of the child seem important but also characteristics of the parent in determining whether help will have any impact on attainment.

I decided to focus this study on parental involvement in primary school mathematics and sought to explore in which cases parental involvement, in the presence or absence of various other factors, was enough, or not, to lead to high attainment. Expecting that parental characteristics may lead to different types of involvement (and hence different outcomes), I also wanted to examine what strategies parents employ to support learning of basic mathematical concepts and to address their children's problems in mathematics as they begin to appear.

The nature and perception of mathematics as a school subject

I argue that mathematics is a subject which does not easily sit in either the group of humanities subjects or group of sciences. The way mathematics is taught to children at school often resembles the learning of a language: there are terms and rules to learn before progress can be made and a technique for reinforcing this is often repetition (Austin & Howson, 1979). To add to this, the predominant view of mathematics is that it is a subject of 'absolutes' (Ernest, 1991). This leads many children (and then adults) to perceive mathematics as having correct answers and wrong answers with no middle ground (Ernest, 1991). Those with low confidence can develop a fear of getting the answer wrong and, as mathematics becomes more difficult, this may worsen. The mathematics curriculum is designed to be incremental and some of the more difficult problems become impossible if elements taught earlier have not been grasped. As a contrast, subjects like English (in primary schooling) have creative writing tasks and interpretation exercises where children are encouraged to offer an opinion. Of course, success in a subject like English also relies on a good grasp of language, grammar and argument formation which are also skills introduced earlier. The key difference, in much of the English curriculum, is that the emphasis on 'right and wrong' has been removed and children have more control over how they choose to attempt an exercise, unlike in mathematics.

Some types of parental involvement

From my initial thinking in this area and from talking to a pilot sample of parents, I found that there are parents who can (and do) help with mathematics homework by, for example, attempting problems themselves or translating mathematical words into terms that their child more readily understands. Some parents may interject during a child's homework session though help has not been expressly sought by the child. Others find that, even though the way their child is taught differs from their own recognised method, they are, nevertheless, still able to work out what is required in a question.

For some parents, the best they can offer may be encouragement for their child and access to support materials such as revision guides and personal tutors. Some parents may struggle to answer homework questions but still ask to see a question and offer a solution. A child may seek to exhaust every other avenue he or she can think of before asking this parent because they do not expect that useful help will be available from them. In certain situations, parents may remember how to answer a question using methods they have been taught but might struggle to follow a different method or understand different terminology.

I consider a wide range of actions and strategies as constituting parental involvement in this study. I do this because I suggest that the type of involvement a parent has could be connected to their own attributes or that of their child. Of course, there will be parents who offer neither practical help nor encouragement. There could be several reasons for this; some of which make an alternative level of involvement impossible. It could be that the parent works away from home, has several jobs or works shifts which means he or she is not available at the time when homework is done. If a stance of non-involvement in mathematics homework is adopted because of negative attitudes to the subject, it is, of course, feasible that a parent may behave differently when asked for help with homework in another subject. In Chapter 2, I explore how parental involvement in mathematics may be different from some other subjects.

Levels of capital

I propose throughout, but first in Chapter 3, that differences in action can be explained by differing habituses – or sets of dispostions. I follow Bourdieu in suggesting that differences in habitus stem from differences in levels, types and forms of capital and that social class position acts as a summary of these differences in capital. I explore this in detail in Chapter 3 and identify some types of cultural capital that I suspect, based on theoretical reasoning, it may be important to possess in order to be able to offer fruitful help in mathematics. I am interested in understanding why parents act in the way they do, how aware they are of their actions and what assumptions they make about mathematics along the way because I suspect this shapes their behaviour.

To try and unpick this complexity, a case study approach proves useful. A child's parent(s) can have different jobs, different levels of formal education and varying levels of resources at their disposal. A parent who perceives (or has been told) their child is coping well may act differently to another with similar resources, jobs and educational qualifications whose child is struggling. In Chapter 4, I explain how I designed the research project and, particularly, how I integrated the analysis of a large, longitudinal dataset with the analysis of a smaller sample of interview data.

Exploring large datasets through questions about mathematics attainment, social background and parental involvement can help to pinpoint trends and show which combinations of factors are associated with a particular outcome repeatedly. To borrow a term from Bourdieu (1984), this helps us to define the 'field' of study. Work on survey data, however, can only give hints as to what is happening, especially, and why it is, and so interviewing parents and children is used here to provide more explanatory depth.

There is the perception that social science research can either be concerned with the general or the particular but not both simultaneously (Ragin, 2000). In this piece of research, I deem it important to consider how a detailed examination of particular cases can shape thinking about the wider situation. Similarly, knowing what trends there are generally can be beneficial for interview preparation by giving an idea of what is worth probing in more detail.

In this vein, the research process of this project has been very iterative in nature. The various stages are documented here in an order which mimics one iteration of that process. In actuality, parts such as the literature review were ongoing tasks which constantly challenged and re-shaped my thinking. The analysis of the large dataset similarly took place in chunks: new leads were followed and variously discarded or incorporated into the final, overall analysis.

The value of a case-study approach

In Chapter 5, I outline Qualitative Comparative Analysis (QCA) which is a case-based approach developed by Ragin (1987) for dealing with small- and medium-n datasets. I use it to identify which characteristics of parents and children are most commonly associated with, in the sense of sufficient for, high attainment. It moves away from the more standard focus on the net effect of a factor under investigation and, instead, considers how combinations, or configurations, of factors jointly produce a particular outcome.

I use QCA to analyse an appropriately large-n dataset and argue that not only is this a possible approach to analysis but it is preferable to standard statistical methods when aiming to integrate case-based survey analysis with the additional analysis of interview data. In Chapter 6, I present the results of the QCA analysis on the large dataset and explore some of the methodological challenges I encountered. Chief among these is the issue of limited diversity in the data. I explore how such limited diversity can be overcome in analysis by discussing two different strategies and giving examples using real and invented data. This develops the work in Thomson (2011, in press).

Explaining different strategies of involvement

I can, then, using QCA, perform case-based analysis on all the data in the study and make cross-case comparisons. I perform QCA on the large-n, 1970 Birth Cohort Study (hereafter BCS70) data and also the small-n interview data to identify configurations of factors (which come close to being) sufficient for high attainment. I suggest that the QCA analysis of the large dataset gives an idea where to 'zoom in' and seek more detail and I obtain such detail from the interview data. In practical terms, this meant that types of people who embodied a particular configuration of theoretically-relevant factors were approached for an interview. In Chapter 7, I outline the characteristics of those interviewed and discuss the different types of cultural capital they employ. Through a semi-structured interviewing technique, participants could be asked about instances when they had helped their children and could offer further information about situations which they perceived to be important and relevant.

In Chapter 8, I specifically focus on other people who have helped in addition to the child's parents. These additional people may have helped directly or could have their help delivered through the child's parents. I consider whether certain types of parents have greater access to those who could provide help and how those who help are chosen. In choosing an additional person to help, parents have to estimate the capability of this person to provide help and the parents' ability to do this could have an impact on whom they choose and, ultimately, how successful the help acquired is.

Throughout the thesis, I treat cases as configurations of factors whether I am performing a QCA analysis on them or analysing the case in depth. This allows me to search for configurations which most commonly *lead* to a particular outcome and to attempt to explain *why* such configurations do by considering levels of capital that a parent possesses.

Chapter 1 – The Social Role of Mathematics

It is important, for my purposes, to understand how the mathematics curriculum (in its various forms) can come to be more or less difficult for various types of parents. In this section, then, I examine, chronologically, some of the key changes to mathematics education since Victorian times. Though I focus on the primary school, I discuss, here, key changes to the mathematics taught at all levels of schooling because this helps to explain how mathematics has come to be such a high-stakes subject in the UK. I summarise these key developments in mathematics education and discuss how mathematics provision has a history of being unequal for children of different sexes and social classes. By this, I mean that the types and levels of mathematical knowledge have been differently distributed by, for example, social class and sex. I examine various attempts to reform the mathematics curriculum and discuss the changes that resulted from them in an attempt to understand how the current system arose. I argue that mathematics has acted in the past (and does act now) as a social filter for access to, for example, secondary education and jobs and, therefore, it has become important for children to succeed in primary mathematics if they are to have access to, for example, the top sets in secondary school. I also directly compare post-1998 primary mathematics to the primary mathematics provision from the 1970's and 1980's to outline the key differences in curriculum content and teaching methods to show how the way parents in the sample were taught differs from their children.

Victorian Times – Different mathematics for different classes

From the middle to late 19th century, there was public debate about the content of school mathematics as part of a broader debate about mass education. Although, by 1861, around

90% of children under 11 were being educated in some form, access to secondary education was extremely limited (Gillard, 2011; Cooper, 1994). A guiding principle of education at that time was for children to receive an education appropriate to their social-class background. This extended to the mathematics they were to be taught with different types being deemed appropriate for some children and not others (Cooper, 1994). The Taunton Commission of 1868 proposed that only children from an upper-middle, professional or mercantile class background were to be taught anything more than arithmetic (Cooper, 1994). Even for those children, the mathematics they were taught was limited to Euclidean geometry.

Around the same time, academic mathematicians and schools' inspectors launched an attack on both the limited content of the curriculum (in all schools) and the 'instrumental' nature of the teaching (particularly but not exclusively in elementary schools) (Price, 1994). The grammar schools and private schools were dominated by classical subjects and most were reluctant to include any advanced mathematics in their curriculum (despite the 1840 Grammar School Act making it legal to change the focus of a grammar school away from exclusively teaching Latin and Greek). In the other, 'elementary' schools, which were almost exclusively populated by working-class boys, only arithmetic was covered (Cooper, 1994). In 1870, the Association for the Reform of Geometrical Teaching (AGIT) was founded, initially, with the purpose of reforming the mathematics curriculum so that it offered a more comprehensive (and modern) education in geometry. The association later changed its name to the Mathematical Association (MA) to reflect growing pressure within its membership for expansion of the curriculum further to include aspects of applied mathematics and mathematical physics.

Payment by results – the beginning of high-stakes mathematics testing

It is certainly possible that one of the main reasons for the instrumental nature of teaching in elementary schools was because of the introduction of ‘payment by results’ after a recommendation by the Newcastle Commission in 1861. Schools were to be held accountable for the progress made by children by linking the size of a school’s grant to exam results in reading, writing and arithmetic from 1867 onwards. The criticism of this plan came from two main sources. Firstly, teachers opposed the plan because their jobs were now less secure and changed in status. The previous status of a teacher was that of a quasi-civil-servant who was paid directly by the state and had a pension akin to that of a civil-servant (Rapple, 1994). After 1867, a school’s grant would be paid directly to its managers and would have to cover all the running costs of the school – even staffing costs – and the teachers’ centralised pension scheme was closed. Hence, teachers became employees who had to grapple for a share of the school grant and depended on good results in their classes and good attendance in their school for their salaries (Rapple, 1994). Arithmetic became a high-stakes subject because of its prominent place in the testing and it was often taught in an exam-focused way (Rapple, 1994).

Secondly, schools inspectors, particularly Matthew Arnold, condemned the changes. His argument related both to the changes it would bring to his job and to the wider social consequences of introducing an exam-focussed system. Arnold argued that payment by results reduced the role of inspector to that of a bureaucrat and would not allow schools inspectors to take the time to ascertain if schools had wider problems. Neither the brightest children nor the weakest ones benefited from this system and children with irregular school attendance often ‘received the least attention from teachers’ (Rapple, 1994). So long as the emphasis in the HMI inspections was on arithmetic, the MA was going to find it difficult to convince schools and policy-makers to expand the mathematics curriculum.

Practical mathematics – the beginning of 'real-life' applications

By 1899, payment by results had been abolished which left more room for alternative teaching methods but now public concerns had shifted from mathematical standards within the UK to a perceived discrepancy in standards between England and other countries (Price, 1994). The Board of Education Act (1899) was passed creating a single, central agency for state education and, as a result of pressure from academics, in the same year, a new subject, 'practical mathematics', was created but only for study by those in vocational education (Price, 1994). One of its champions, Professor John Perry, argued that a broadening of school mathematics was essential if it was to be learned by more than just those children from the highest social classes (Price, 1994). A key thing to note here is that 'practical mathematics' resembled what we might now call 'applied mathematics' and included aspects of calculus, graphing and decimals which were new concepts for most learners. It was practical in the sense that it better prepared those studying it for technical careers but still required academic rigour and was not widely available in elementary schools (Price, 1994). Perry himself suggested that it could be introduced to elementary schools as useful training for those wishing to follow a more technical career.

The Haddow Report – the creation of primary schooling

In 1902, The Balfour Act created local education authorities (LEAs) who were responsible for providing the schooling provision in their area. Alexander (2000) argues that this change reduced the opportunities for working-class children to receive any form of extended education because places in secondary schools[1] were limited, secondary

[1] Here, I mean schools attended post-elementary i.e. after age 14

education cost money and the extra classes in secondary subjects[2] for working-class children run by some school boards (which the LEAs replaced) had been discontinued.

This patchwork system of mathematical provision continued for many years. In 1918, the school leaving age was raised from 11 to 14. What children studied post-11 largely depended on what type of school they attended and this, in turn, was influenced by their class position and gender. Girls were more likely to study only arithmetic and the elementary schools, which were mainly populated by working-class children, were officially expected to teach a 'non-academic' mathematics syllabus which was 'practical' in nature (Cooper, 1994). Here, the term 'practical' did not refer to Perry's applied mathematics but, instead, to a syllabus which privileged arithmetic and gave children an introduction to mechanical drawing and graphs so that they might learn geometrical concepts later.

In 1926, the Haddow Report established primary and secondary schooling as separate stages. The transition between the two tiers took place then, as it does now, at age 11. For working-class children, this amounted to splitting their (old) elementary school in two - they would attend a primary school then a modern school (Alexander, 2000). Since the type of school attended was still very much pre-determined by a child's social class, the mathematics working-class children had access to was still limited.

Now that primary schooling was seen as a separate stage, the government claimed it was serious about reforming it in response to the educational research of the time. In particular, in 1931, statements which hinted at ideas from Froebel, Rousseau, Pestalozzi, Herbart and Montessori were included in a government report about what the primary curriculum should be (Alexander, 2000). Crucially, though, an English psychologist, Cyril Burt, was also very influential around this time and he pushed for streaming in primary

[2] Though it is not explicitly stated, Alexander (2000) talks of these subjects providing a 'stepping stone to grammar schools and skilled occupations' and so I would expect that some of these classes were mathematical in nature.

schools so that children would be taught in groups of like ability which would reflect their schooling destination post-11 (Alexander, 2000). Streaming, once again, allowed a teacher to tailor what was being taught to which class of children which provided a further layer of differentiation within the primary school. Alexander (2000) notes that this mirrored the tripartite system which was to be introduced in to secondary education some years later.

The Tripartite system – mathematics as an educational filter

The 1944 Education Act performed a key role here in changing the formal government position about the type of education children should receive. The act made secondary education free to all and used the 11-plus exam as a filter for access to grammar school. So, in theory, children were now being selected on ability and not explicitly social class, as before. As Cooper (1994) notes, however, that class differences in the type of schooling persisted with working-class children more likely to go to secondary-moderns and middle-class children more likely to attend the (more prestigious) grammar schools.

Unlike in previous generations, the type of mathematics on offer from 1944 was not explicitly divided up by social class but now, a test with a considerable mathematical element was being used to select which children were ‘able’ enough to attend an academically-focussed secondary school. While it was certainly possible for working-class children to pass the 11+ (and many did), those working-class children who did fail would go to a secondary-modern (or technical school, though these were rare) whilst a much higher percentage of their middle-class contemporaries had, in addition to the grammar school, the option to attend a private school and study more academic subjects and, in particular, a more academic version of mathematics (Halsey, Heath, & Ridge, 1980).

Plowden Report and progressive mathematics

It took until the 1960's for the type of mathematics curriculum reform the MA had envisaged around the time of its foundation to be implemented in schools. By the 1960s, the secondary education system in England was changing rapidly but the last government-commissioned report into primary schools had been the Hadow Report in 1926. The Plowden report, released in 1967, was highly anticipated by those in the teaching profession (Gammage, 1987). Developments in the field of educational psychology were challenging the existing ideas about how young children learn and how they should be educated. Particularly influential, was the work of Piaget and the 'child-centred' nature of the curriculum post-Plowden reflected this (Halsey & Sylva, 1987). Piaget's (1970) ideas emphasise individual cognitive development suggesting that children progress through a series of stages on their own (but in interaction with their environment) and these ideas were, at this time, used to explain how mathematical learning may occur in children (Ojose, 2008). Another key emphasis in the Plowden Report was the role of parents in education. In Chapter 2, I will outline the increasing demands made of parents with primary-age children but it is worth noting here that encouraging the involvement of parents reinforces the idea of the child as an individual learner.

This individualised way of educating was very different from the previous standards-based agenda and was reflected in changes to not only teaching methods but also the curriculum for mathematics (and other subjects). The School Mathematics Project (SMP), which had originally been developed for the top 20% of children, issued a revised series of mathematics textbooks and resources which became popular in secondary schools (Cooper, 1994). This led to fewer children studying arithmetic alone (Cooper, 1994).

It was not long before concerns about standards came back to the fore (Alexander, 2000). The economic situation in the country led to questions about education spending and the consensus underpinning the new, revisionist teaching crumbled (Gillard, 2011). Those in favour of the secondary school reforms had been aiming, by widening the mathematics curriculum available to most children, to narrow the gap between school and university mathematics (Cooper, 1994). Employers, however, began to complain about the poor mathematical ability of school leavers and blamed progressive teaching in primary and secondary school (Cooper, 1994). The Black papers, a series of papers seized upon by right-wing media, served to further this view and argued for a market-based education system with increased parental choice (Gillard, 2011). This choice was advocated for both primary and secondary schooling which acknowledged that some primary schools were seen as more effective. As these debates were taking place, however, the structure of secondary schooling was being changed by politicians.

With the Education Act in 1976, many hoped that full comprehensivation of education would occur (Gillard, 2011). Soon after, the 11+ was abolished in parts of England[3] and, by this point, streaming was disappearing from primary schools (Alexander, 2000). This did not, however, signal a shift away from the underlying ideas of streaming and selection in education as a whole. The act was riddled with loopholes which meant that selective schools could still operate (Gillard, 2011). Though, in many areas, children of all abilities now attended comprehensives together, streaming was used to vary the type of mathematics on offer. Those in top sets were entered for O-levels and then A-levels, if they stayed at school, whilst those in the lower sets were entered for the CSE examination – a less academically-prestigious qualification. A mathematics O-level was required for entry to many university courses and jobs and so, under this system, mathematics was still acting as an educational filter, albeit at a later point in the education system – at 14, instead of 11. In 1979, the Education Act was repealed by the Conservative government who also called for national enquires into all aspects of progressive education (Gillard, 2011).

[3] Not in Lincolnshire, Berkshire, Buckinghamshire, North Yorkshire or Kent.

The inception of GCSEs – mathematics for all?

Critics of the two-tier exam system complained that it was difficult to understand for employers and parents and that children taking CSE were not fairly rewarded if they did well. A child gaining 100% in a CSE would have obtained the equivalent to a grade 3 (later known as a C) in O-level but the actual qualification they received was still a CSE. In 1988, the exam system was overhauled again so that all children would study for the same qualification – a GCSE[4]. The grading scale for GSCE was (and still is) much broader than the old qualifications with a grade C being taken as a sign of general competence and being asked for by employers and universities. Though all children now studied for the same qualification in theory, in practice little changed. Children were still taught in ability groups and entered for different papers. Most GCSE subjects had two tiers, A-E and C-G, and children sat exams in either one of these tiers. Mathematics, however, operated a three–tier system which retained similarities with the old O-level/CSE distinction. To obtain a grade C or above, children had to be entered for the top or middle tier.

The National Curriculum

A far more influential change also came in 1988 when the National Curriculum was introduced. This made some study of mathematics compulsory to age 16 for the first time but, later, children were able to opt out of GCSE mathematics to take an entry-level qualification. The new curriculum was prescriptive and came with lists of standards that were to be met by each child. Teachers complained that it de-professionalised them and that they were expected to 'deliver' the curriculum instead of teaching it (Gillard, 2011).

[4] The new GCSE course was taught from 1986 with the first pupils sitting exams in 1988.

The National Curriculum not only reformed the secondary curriculum but also the primary one. Children were to be assessed at ages 7 and 11 to ascertain whether they were meeting the advised national standards in English, Mathematics and Science. The mathematics portion (along with science[5]) was to be assessed by test at both ages 7 and 11, whilst the earlier English test is a subjective, teacher-judgement with only the standard of English at 11 being examined by test. Children are measured against 'standards' which combine to create levels. Many secondary schools use these levels as a guide when creating sets (which not all schools have for the lower classes in secondary school) and children and parents are informed whether progress is below-average, average or above-average.

Numeracy and Literacy – a narrow curriculum

Though schools in England had been inspected since 1839, the nature of this inspection process changed considerably after the implementation of the National Curriculum (Alexander, 2000). In 1993, the Office for Standards in Education (OFSTED) was created to replace Her/His Majesty's Inspectorate (HMI) and, although many of the staff from the old HMI were retained, the new inspectorate was expected to perform a different function. OFSTED had greater powers than HMI and was not independent which Alexander (2000) argues made its remit primarily about the validation of government policy.

In 1997, as one of their election pledges, New Labour outlined their proposals for raising standards in primary numeracy and literacy. These included prescriptive 'Literacy Hour' and 'Numeracy Hour' lesson formulae which were to be followed in every school. The creation of a centralised lesson showed that the Labour government (as it became in 1997) was pushing a particular pedagogic view but not just by endorsing it but by making it compulsory. Teachers were no longer making a pedagogic decision, the government was

[5] Though, SATs exams in science were later dropped.

(Alexander, 2000). The National Numeracy Strategy (NNS) was implemented in 1999 and marked the end point of a gradual de-individualisation of teaching and learning in primary schools. This standards-led approach with its government-dictated lesson structures left little room for the "spontaneous" learning of mathematical concepts that Piaget had envisaged. Further, it privileged the learning of English and mathematics to such an extent that other subjects were pushed to the margins so children were unlikely to be able to come to their own understanding of how mathematics permeates aspects of everyday life.

The Cambridge Review

The major education reforms of the last 100 years have fluctuated between those which seek to narrow the curriculum (and the methods used to teach it) to protect standards and those which favour a broader curriculum and more progressive, individualised approach. In 2006, the Cambridge Review of Primary Education was launched 'as a fully independent enquiry into the condition and future of primary education in England' (CRP website, accessed 2011[6]). A key theme of the review is that broadness in content and high standards need not be clashing ideals in primary education. In fact, the review seeks to re-establish a minimum entitlement, which Alexander (2011) suggests was the National Curriculum's original aim, covering a broader range of subjects than at present.

The problem, Alexander (2011) argues, is that only the basics have protected standards. Since mathematics, English and science are the only subjects assessed by Statutory Assessment Tests (SATs) (with some aspects by teachers, others by exams), they take priority in the teaching timetable and the provision of other subjects can be very weak (Alexander, 2011). What Alexander neatly highlights is that, most recently through the creation of the National Numeracy and Literacy strategies, the government has stated,

[6] http://www.primaryreview.org.uk/

explicitly, what it considers to be the foundation of a basic education for primary children and has established mathematics as a priority subject at the expense of others. Schools which have to invest more time to get children to the required levels in SATs invariably teach the narrowest version of the curriculum and may ask more of their parents in terms of at-home support. This impacts most strongly on those children who receive no additional help with curriculum topics at home and whose parents have the lowest levels of education and educational confidence.

Summary

So, from the inception of mass education in England, attainment in mathematics has played a key social role in access to continued education and, then, jobs. Campaigns to reform what was taught in mathematics led to a broader, more applied curriculum which was, eventually, in some form made available to all (at least, in theory). Far from being a merely notional indicator of ability, mathematics has played a role in who attends which type of school, who attends university and who gets which jobs. Secondary mathematics has always been a high-stakes subject but primary mathematics has also become high-stakes, since the inception of the 11-plus and, then, SATs.

I would argue that, historically (for example, in Victorian times), the barriers to studying mathematics and, hence, to a high-quality secondary education and/or high-status job were explicit. They were articulated as policy or seen as a natural extension to the way the rest of society functioned. Various reforms chipped away at each of these institutionalised barriers with the stated aim of creating a curriculum, including mathematics, that was more accessible and could be studied by anyone who could cope with it, academically[7].Though our education system is now more superficially equal (though streaming does still exist),

[7] See National Curriculum 'Statement of Values' http://curriculum.qcda.gov.uk/key-stages-1-and-2/aims-values-and-purposes/values/index.aspx

we, instead, have implicit barriers to mathematics education. These, in a sense, may be harder to remove because they can be intertwined with a person's sense of self and may be present in assessment, a heavy feature of mathematics.

In the next chapter, I discuss the place of legitimised knowledge in mathematics and how this can produce an implicit barrier for parents when they want to help their children. I also explore how to compare the different types of involvement parents may have and how this may link to their conception of mathematics as a school subject.

Chapter 2 –Parental Involvement and Mathematics

In order to examine parental involvement in mathematics, I, firstly, briefly explore the role of parents in education historically and suggest, though there is now a compulsory system of schooling in the UK, there is an increased emphasis on the parental contribution to a child's learning. I then explore how school knowledge gains legitimacy both in general and in mathematics specifically. I suggest that ideas about the legitimacy of school-acquired knowledge (and the notion that knowledge acquired outside school is somehow not legitimate) runs contrary to the expectation that parents help their children with learning in the home. Finally, I explore some theories about differences in types of parental involvement and how some of these types utilise, more than others, the legitimate knowledge preferred by schools. I suggest thinking of the configurations of attributes parents possess as classifying them as different types and discuss whether it is possible to conceive of the 'ideal' configuration of attributes a parent could have for helping with mathematics.

<u>Theories of education: who is responsible for educating children?</u>

A useful place to start when considering the role of parents in education is to consider Locke's (1996 [1695])[8] work 'Some Thoughts Concerning Education'. What was originally intended as advice for a friend was seized upon as a "manual for parents" (Tarcov, 1984). Locke's (1996 [1695]) strong commitment to what he termed "moral laws" meant that he treated the education of children as a *responsibility* of parents. Locke (1996 [1695]) believes that a child learns through imitation of those around him and, therefore, suggests that the child should never witness something the parents do not want it

[8] I will cite this work throughout as '(Locke, 1996 [1695])' to indicate the edition being referred to here. This work is a reprint of the 1695 translation is considered the earliest faithful translation into English.

to repeat. This raises two interesting points: firstly, that education (as distinct from schooling) is constantly taking place and that parents may want greater control over who educates their child. These two points will be expanded later in this chapter (and in Chapter 3) with a view to unpacking the idea of "parental involvement" and theorising it. Locke (1996 [1695]) was heavily against learning blind facts which, he argued, did not allow children to develop a rational understanding of what they were studying. He suggested that children should be taught ways of thinking that allow them to make connections between different strands of knowledge. This highly unusual, for the time, treatment criticised favouring privileged knowledge (such as Latin) over the newly emerging field of science.

His thoughts were also unusual (for the time) in the sense that they placed responsibility for the maintenance of social order in the hands of individuals. For Locke (1996 [1695]), education was the means to understand laws (both moral and of nature) and therefore essential to perpetuate a functioning society. The responsibility to educate was synonymous with social responsibilities. Social norms, he argued, should be created and sustained by the habit-forming practices employed by tutors of children. Once the child understands these practices, he is free and can stop being educated.

Though there were no schools (as we now understand them) around in Locke's time, his philosophical thoughts suggest that education is an ongoing process. If it is based (as he suggests it is and should be) around imitation and the formation of routine, this will encompass most areas of life and cannot be restricted to specific time periods. The implication for who educates the child is slightly more contentious. Since the Education Act of 1944, it has been a legal obligation for parents to ensure their children receive an education and this most commonly will happen in a school (MacLeod, 1989). This leads to varying levels and kinds of interaction between parents and schools. Interaction, as an idea, requires unpacking and explanation, though, because it can take many forms.

Locke could not have foreseen the mass expansion of secondary state education that would occur after 1944 but Illich (1971), with schools as his focus, argues against the very socialising process Locke had advocated. For Illich (1971), schools are places where learning has become institutionalised. He suggests that this can only lead to a greater degree of institutionalised behaviour in society where people have less (and not more, as Locke (1996 [1695]) suggests) freedom.

There are elements of agreement in the thoughts of Locke and Illich. Both see education as having a crucial role in forming the structure and norms of society and both emphasise the freedom of the individual. Where Locke (1996 [1695]), however, sees individual reasoning as leading to collective conclusions about the world, Illich (perhaps with the benefit of hindsight) argues that educating in a collective setting severely limits the chances for individual reasoning. In particular, Illich (1971) is critical of the lack of flexibility in schools' structures which, he argues, leaves them unable to adapt to an ever-changing society. This produces an interesting comparison with the ideas of Locke (1996 [1695]). Locke's insistence that responsibility for education should rest with the individual leads to the reproduction of societal norms in a responsive way and, in that sense, may be said to be very flexible. Despite this, however, information is transmitted from one person to another which is preceded by selection of information. Illich (1971) argues that it is this privileging of information that brings inflexibility. Instead of being able to think freely, as Locke (1996 [1695]) suggests, children become accepting of someone else's values and ideas.

<u>The place of legitimate knowledge in schooling</u>

Of particular concern to Illich (1971) is, what he sees as, the restriction of legitimate schooling practices to those which take place inside the school. This has obvious implications for the role of parents and characterises the education in the home as inferior, in some sense. This may seem sensible as teachers are qualified education professionals and parents are (in most cases) not. Problems can arise, however, when the level of education of parents is greater than or equal to that of a teacher.

There have been suggestions that Locke's views would not have been consistent with education as delivered through schooling (Yolton, 1985). His emphasis, however, on responsibility for learning is not completely at odds with a school framework. Both Locke and Illich are helpful for forcing the examination of schooling: its purposes, methods of delivery and how this changes the role of parents. While they may have both disagreed with a mass programme of schooling, this is the system that exists currently and all analysis in this thesis will take place within the framework of mass schooling.

Illich's (1971) points about where legitimate education is located could be taken to an extreme end where parents have absolutely no involvement. Government policy in the UK is full of references to the role of parents and schools are encouraged to build links with families and the wider community. Research suggests that, however, there are a great many cases where these links do not appear or only appear with certain sections of the parent body. As an extreme example, in the boarding school context, the school becomes solely responsible for the academic and pastoral side of a child's development for almost half the calendar year. The value structures of parent and school are likely to be very similar in this case or, at least, the parent is placing the value structure of the school above their own (while the child is away at school). Here, the distinction between parenting and schooling becomes blurred with both being delegated to the school. This is, at least, an expectation of a school of this type.

There is another point to consider here, though. For the period when the child is not at school, they could be returning to a home-life which places emphasis on different values and practices. In this case, the child could experience confusion upon return to the school. If we consider education in the broader sense like Locke did, then the conflict between home and school becomes internalised within the child instead of being something outward which can be observed. This internalisation of conflict may be easier to imagine in the boarding school context but, I would argue, is likely to be present in many more children attending day schools.

The distinction between parenting and schooling seems, superficially, to be easier to draw when the child attends a day school. It could be assumed that parenting occurs in the home and schooling occurs in the school. We know, however, that this interpretation is much too simple to capture educational activities in the home and elements of parenting occurring in schools. For example, as I show in Chapter 7, parents may introduce elements of schooling into their routines at home. Locke's (1996 [1695]) idea of teaching a child how to think requires some unpacking too. In that case, the purpose of education is to give or develop tools of learning which enable children to tackle unseen situations and make sense of them. This is a different set of purposes from those of modern education (whatever the explicit, stated aims say) and has implications for what is (and can be) taught.

In the specific case of mathematics learning, however, we must consider if (and how) someone could learn to think. Hirst (1974) suggests that "knowledge-that" (a term first used by Phenix (1964) to describe knowledge of the workings of an object) is not separable from a knowledge of the facts of that object. That is to say, it is possible to deduce things about an object, say a computer, but first there must be some knowledge about that object. What can be deduced is linked to the knowledge of the object possessed by the individual and can be limited by a lack of knowledge. In contrast to Phenix, Hirst (1974) stresses the interconnectedness of truth statements and knowledge. For Hirst (1974), knowledge is inferred from things that are established as true. Of course, what is true is always open to debate but Hirst (1974) suggests that there are certain things which are agreed as true, in a "public forum", and these form the foundation of any quest for knowledge.

This position echoes that of Ernest (1991) who suggests that mathematics does possess statements of truth (often expressed as axioms) and these can be tested by the academic community. Ernest (1991), in taking this view, sits between those who claim mathematics is nothing but certainties and those who propose that certainties cannot ever exist. For Ernest (1991), the use of the academic community (or, in Hirst's (1974) words "public forum") as a verification tool allows new ideas to be proposed whilst protecting the status of previous discoveries.

Legitimacy in mathematics education

The key to understanding Hirst's (1974) position and its implications, I argue, is to think about the truth statements themselves. How does a person find out what is true? Where does this information come from? In mathematics, most proofs are constructed by deducing from and fitting together axioms. These are mathematical facts which have, themselves, been proved at some earlier stage. Working backwards in this way eventually leads to the use of definitions. These are statements about the structure and properties of, say, a set of numbers which allow a mathematician to know, in advance, certain elements of behaviour. This is where we encounter a problem. These definitions have to be taken as true in order to proceed but there is no way to prove them in the sense described above. They are learnt in order that a mathematician may go on to deduce novel things. Hirst's (1974) idea that knowledge requires truth statements would, then, seem to make sense in the specific case of mathematics.

The mathematics curriculum is certainly constructed with truth statements in mind. Bibby (2002) suggests that the primary curriculum for mathematics is full of "lists of facts, skills and competencies" which have to be remembered or mastered to attain at various levels. Secondary level mathematics has, too, become very assessment focussed which, I argue, can lead to the reduction of the subject to a set of outcomes (Cooper, 1998). This focus on assessment and approved lists of facts creates the impression that mathematics is a subject with limited interaction with the world. Yet, at the same time, there is a huge emphasis on so-called real-life examples and applied questions. This can be a source of confusion because these two ideas do not knit together well and are, in fact, almost contradictory. If the purpose of mathematics is not clear at this fundamental level, it can become confusing for those learning it and the people (including parents) who are supporting them.

Facts and skills are not, however, the only form of mathematical truth statements that must be understood to be successful in mathematics. To aid with the precision of expression, there are a myriad symbols and descriptions of properties. To make sense of a question or statement requires familiarity with these. Though there are slight differences due to the influence of, for example, physics or engineering, the language of mathematics is generally universal. The problem arises when mathematical language is confused with standard usage.

Tapson (2000) suggests that problems arise when either standard usage offers a different word to mathematical language for the same object or concept or if a different object or concept appears in standard usage and is known by the same name as a mathematical one. Of course, standard usage is what most people will recognise and use to describe situations they encounter – even when a more precise term exists in mathematics. The reason for this is the majority of people will not be familiar with mathematical language and those that are will not find it a useful communicative tool unless they are talking to someone else with the same knowledge. In this way, mathematical language could be seen as a form of cultural capital, and therefore related to class position, and is theorised as such in Chapter 3.

While it may be relatively easy to identify (and sometimes remove) physical barriers (such as lack of knowledge of the mathematical language) to parental involvement (through Government initiatives or funding), psychological barriers remain. Research suggests that psychological barriers (such as a lack of educational confidence) are particularly pertinent when considering working-class parents (e.g. Reay, 2005) and parents from ethnic minorities (e.g. Crozier, 2000). If we look for physical barriers to involvement and find none, this does not necessarily mean that there are good working relations between home and school. The tensions between home and school will be explored in the interview analysis in Chapters 7 & 8.

How can parental involvement be measured?

In order to characterise involvement in a meaningful way, it's necessary to look beyond just location and more at the nature of the act of involvement itself. Typically, this will involve the interaction of parents, teachers and children and, I would argue, requires an examination of the relative levels of cultural capitals involved (see Chapter 3). I examine some distinctions made by other researchers when characterising individual acts of involvement according to time spent, who initiated the involvement and how closely the involvement relates to the curriculum being followed by the child. The purpose of this discussion is to identify which types of involvement most closely align with legitimate knowledge. I show in Chapter 3 how this legitimate knowledge can be thought of as a form of cultural capital but, for now, explore some categorisations of parental involvement and discuss whether these will be helpful to consider later when I analyse interview data in Chapters 7 and 8.

Different types of involvement

Academic and practical involvement

Since the formal mathematics curriculum draws on a large body of specialised knowledge, described by specialised language, it makes sense that a certain level of educational attainment is required to access it. For Bourdieu (1986), educational qualifications are an indicator of cultural capital in that they are non-monetary indicators of status and can be exchanged for other types of capital.

Distinguishing between academic and practical types of involvement gives a way of investigating the nature of the act of involvement. A parent may well ensure that homework is done without aiding the child with the tasks in the homework. Academic involvement is any situation where the parent deploys knowledge or skills to aid the child. Separating these two types of involvement helps to locate where a parent may have a reluctance or inability to help. Reay (1998b) found that the single mothers in her study had low levels of formal education and tended to offer more practical assistance to schooling such as preparation of lunch or washing of uniform.

Once the type of involvement has been established, there can be an examination of other relevant factors, such as the educational levels of parents, which could help to construct knowledge of causal chains. In many accounts of parental involvement, there is emphasis on the physical location of involvement (i.e. community, home or school) and consideration of the type only in terms of whether it relates to work in the classroom or governance of the school[9]. There is seldom a thorough examination of the skills (or capital) required to help complete, say, a piece of homework.

Pre-emptive and reactive involvement

Deciding whether an act of involvement is pre-emptive or reactive incorporates elements of what Lareau (1989) terms 'compliance' and is bound up in ideas of what types of involvement is legitimate. This distinction can highlight, again, parents' skills but also can show whether there is a difference in the normative values of the school and the parents. A pre-emptive act of involvement occurs without prompting by the school. In work by de Abreu et al (2002), parents insisted on testing knowledge of times-tables regularly even though this had not been specifically requested by the school. A reactive piece of involvement is one not conceived first by the parents but by the school. In the most

[9] See Epstein and Sanders, 2000; Sayer, 1989; Vincent, 1996.

extreme sense, it is carrying out the express wishes of the teacher (or school) exactly as they have been requested. For example, a teacher may request that a parent spends 30 minutes a day testing children on foreign language vocabulary by using a series of picture cards. The purpose of this example is to show the limited nature of the parent's input, here, as every element of how the exercise should be carried out is specified. Distinguishing between pre-emptive and reactive also gives a more nuanced picture than simply considering the responsibilities of a parent. Responsibility for education has long been a contested point in educational theory but one that requires a more detailed treatment in the modern setting. It could be argued that a parent who engages in several hours a day of pre-emptive involvement is being a responsible parent. If, however, this leads to an exhausted child who is unable to concentrate in lessons, then the parent may not be considered to be acting responsibly. The concept of responsibility is value-laden and often parents can be termed irresponsible when they are only guilty of having a different concept of responsibility from that of the school or the majority of parents. Where involvement is pre-emptive, what parents deem important is being prioritised while schools' values are transmitted through reactive involvement.

Time spent on involvement

Another common facet of involvement used to show interest is the time spent on involvement (Lareau, 1989). While in certain situations measuring the time spent could be helpful, it is more meaningful, I would argue, to consider whether an activity is repeated or a one-off. Repeated activity is a sign of habitual behaviour which, again, can indicate the presence of priorities. For Locke (1996 [1695]), instigating habits was the first step to achieving an education. By using the earlier academic/practical distinction, we are also in a position to identify working habits to see if they comprise primarily instances of rote-learning.

When involvement is categorised as one-off, this may not necessarily have negative connotations. It could take the form of a revision session for an exam or a trip to see a relevant museum exhibition. It may seem that repetitive and one-off examples of involvement are oppositional but, in keeping with the framework developed above, the involvement across the subject as a whole would be considered. It could be that in an exam-driven subject, such as mathematics, there are high occurrences of one-off involvement as well as high regular involvement.

Examining whether an act of involvement is one-off or regular may also give clues to deployment of capital. Instances that may be regular for one child could be more sporadic for another because of the capital required. This could be in terms of the necessary cultural capital or even economic capital (for example, in the case of the museum visit mentioned above). What should be clear by this stage is that, in order to make fuller sense of acts of observed parental involvement, there needs also to be an examination of the parents who are behind such involvement.

Categorising types of involvement

When examining acts of involvement in this way, it is also important to consider whether the factor being described is being measured objectively or normatively. That is to say, are all parents being given a score without reference to the others in the study or is some kind of ranking system being employed? An example where this may make a difference comes when considering the time spent on involvement. Is it more useful to record the hours spent by each parent (or set of parents) and use this directly? Or would it be more helpful to term each parent as variously below-average, average or above-average in terms of time spent relative to other parents? In the absence of any examination of pre-emptive involvement, it can often be left to teachers to make judgements about a parent's level of interest. In the 1980 sweep of BCS70 (which I analyse later, in Chapter 6), the measure of parent interest is teacher-judged. In the context of the survey, it was perhaps not possible to categorise types of involvement as proposed here but, asking for a value-laden assessment of an already value-laden concept may lead to distorted results as teachers could let their preconceptions about some types of parents influence their judgements of such parents (Dunne & Gazely, 2008). Parents could, for example, be categorised as uninterested when they fail to share the values of the school and involve themselves in the ways suggested to them by the school. An alternative to a teacher-judged measure of parental involvement is one which is self-reported by parents (as is the case in the 2004 sweep of BCS70). This type of measure could be distorted by parents claiming a higher level of involvement than they actually have. I note here that any measure of parental involvement in a large dataset will have weaknesses and that these should be considered during analysis. In order to use the BCS70, I accept the measures of teacher-judged parental interest in the 1980 sweep (and the self-reported version from parents in the 2004 sweep) as being the best indicators available to me for parental interest.

Summary

I have suggested, in this chapter, that a consideration of parental involvement in mathematics must be coupled with ideas of what is termed legitimate knowledge in mathematics. I argue that methods and content associated with school mathematics are considered more legitimate than other forms of mathematical activity and that, if parents choose to (or can only) offer support of another form, their efforts may not be well received by schools.

Parents, however, will have varying degrees of experience with legitimised knowledge and skills and so may find themselves offering different types of assistance to their children. I discussed several ways that involvement could be categorised but, because of my focus on legitimate knowledge (and skills), decided to consider parents as having different sets of attributes which render them with a varying degree of access to this legitimate knowledge.

In Chapter 3, I outline a theory of capitals to help me to explore further the notion of legitimacy and, particularly, to suggest that legitimate knowledge can be considered what Bourdieu (1986) terms ‘institutionalized capital’.

Chapter 3 – Towards a Theory of Multiple Capitals in Mathematics Education

In this chapter, I aim to establish a theoretical framework which will allow me to analyse why certain types of parents find it easier to help their children with mathematics and why some parents are able to offer more effective help than others. I consider the work of Pierre Bourdieu and, particularly, examine his ideas about symbolic capital and habitus and apply these ideas to the specific context of mathematics education. I suggest that we can conceive of parents as having differing levels and types of capital and examine whether particular compositions of capital may be more advantageous for helping.

Bourdieu's theory of capital

For Bourdieu (1986), capital is 'accumulated labour' which exists either in a material sense (such as money or economic capital) or a symbolic sense (where it is sometimes inseparable from the person with the capital). Forms of capital can be thought of as containing value which, if exchanged, allows their bearer to 'appropriate social energy in the form of reified or living labor' (Bourdieu, 1986). In essence, a theory of capital such as this attaches value not only to material goods but also to the product of repeated, social action whether that takes the form of learning a new language, practising for a music exam or regularly attending a club.

Bourdieu's (1986) ideas about capital could be seen to stem from a Marxist conception of labour and value but he extends the Marxist idea of capital as purely an economic substance to account for the value of, for example, educational qualifications and social contacts. Karabel and Halsey (1977), however, suggest that Bourdieu's ideas stem more from the French tradition, epitomised by Durkheim, and also borrow heavily from Weber.

In fact, as Jenkins (1982) argues, and I would agree, Bourdieu appears to have traces of both Marxist and Weberian thought in his work because he does draw on both and attempts a unification of their positions. For Bourdieu (1986), capital is anything, economic or symbolic, that can be stored and deployed for some sort of return in a competitive market.

Habitus

A recurring theme in Bourdieu's work is the idea of habitus – presented as a way, I suggest, of theorising class action without adhering to either a rational-action perspective (typified by Weber's (1920) ideas on *zweckrationalität*) or a more Marixist one (where there is an objective class structure (class-in-itself) and a subjective one (class-for itself)) (Scott, 2000)[10]. My understanding of habitus is of a set of dispositions which forms the basis of social action and, for Bourdieu, links objective societal structures to individuals but there are a range of interpretations of 'habitus' across social science and differences in nuance in Bourdieu's own work. Jenkins (1982) suggests that the notion of 'culture' encapsulates the essence of what Bourdieu (1977) meant and compares the notion of 'culture' to the 'base', in Marxist language.[11] For Reay (1995), 'habitus can be viewed as a complex internalised core from which everyday experiences emanate'. Both these interpretations correspond with an aspect of the notion of habitus in Bourdieu's own work but place emphasis on the social aspect and the individual aspect respectively. For Bourdieu, habitus provides an explanation both for collective similarities in behaviour through 'lasting, transposable dispositions' and for the maintenance of societal class structures (Bourdieu, 1977; Bourdieu and Passeron, 1990). The usefulness of the concept of 'habitus' has, however, been questioned in educational settings with The Tooley Report

[10] Scott (2000) presents these descriptions of Marx and Weber but the link to Bourdieu is mine.

[11] In Bourdieu (1977) and elsewhere, habitus is described as structural in nature and so could be seen to correspond to the notion of 'base' in Marxist thought. Jenkins'(1982) suggestion of 'culture' as an equivalent concept is confusing when thinking in Marxian terms as 'culture' is included in the superstructure of society and not the base. A possible way of reconciling these two notions is to conceive of collective habitus, that is the habituses of a large group of people, as defining culture.

famously suggesting that Bourdieu's work is too often accepted, without critique, and the concept of habitus, particularly, 'seems so slippery as to be useless' (Tooley & Darby, 1998).

Habitus is, I argue, a way of conceptualising the link between a person's levels of capital and their behaviour. As I discuss later, possession of certain configurations of types of capitals can alter a person's habitus and, in turn, their behaviour over a long period of time. In this way, seemingly inconsequential decisions in everyday life become, over time, a distinctive set of internalised dispositions which are shared with others in a similar class position. As I show in Chapters 7 and 8, this is the link between class position and action and can explain why people of a similar class may act in a similar way in a given situation. So, the relationship between habitus and societal structures is reflexive – habitus is shaped by and shapes society or, as Bourdieu (1977, p72) suggests, is a set of 'structured structures predisposed to act as structuring structures'. Bourdieu (1977), here, I contend, seeks to emphasise the historical development of a habitus and its transformative role in society. The use of 'predisposed' may sound worrying to those concerned that Bourdieu's work is overly deterministic and denies actors their agency but, taken in context, I argue that Bourdieu is emphasising what is 'bound to happen' as society evolves and new tastes, and then cultures, become dominant in society. As Jenkins (1982) notes, Bourdieu is concerned with symbolic relations and how they contribute to the maintenance of societal structures. It is here that he is most similar to Weber.

Though habitus is a set of 'unconscious' dispositions, its application is not limited to 'undifferentiated and unrationalized regions of social space and time' (Brubacker, 1993). Brubacker (1993) uses the example of athletes to show how an individual's dispositions are incorporated into a 'specialized [practice]'. Bourdieu describes the formation of habitus as a product of history and an individual's subjective interpretation of their location within objective social structures (Bourdieu and Passeron, 1990). These social structures are maintained, Bourdieu (1986) contends, through behaviour driven by habitus which derives from an individual's levels of capitals. For him, 'it is impossible… to account for the structure and functioning of the social world' unless we conceive of capital existing in many forms, not just economic' (Bourdieu, 1986). Thinking purely in economic terms leaves us with only economic questions to consider. Without supplementary forms of capital, we cannot, for example, conceive of a link between parental levels of education and a child's attainment except by considering, say, how the parents' (or parent's) level of education influences their job prospects, financial position and, subsequently, the child's attainment. In effect, a direct analysis of social systems proves impossible.

Whether Bourdieu successfully manages to link the subjective and the objective is a point of contention for some commentators. Jenkins (1982) suggests that, so long as social actors subjectively interpret 'objective' social structures, their actions contribute to reproducing these 'objective' social structures for themselves and those around them. My use of inverted commas around 'objective' should be a clue as to what Jenkins (1982) is taking issue with here. For him, habitus is, in fact, a set of subjective 'generative principles', generated by objective societal structures, which leads to objective practices (Jenkins, 1982). The subjective part, he argues, is lost and a deterministic framework prevails leaving little room for the subjective agency of social actors.

In opposition to this view is Hilgers (2009) who suggests three main reasons which Bourdieu's conception of habitus, and his ideas more generally, are not determinist. Firstly, he argues that habitus forms the basis for an infinite number of actions and represents, what Bourdieu (1967) calls, drawing on Chomskyian linguisitics, a 'generative grammar'. Secondly, he suggests that habitus is permanently mutating (Hilgers, 2009). By this, he means that actions are influenced by an actor's habitus but can also change an actor's habitus. Thirdly, the limited nature of sociological understanding does not allow us to account for every factor which contributes to an actor's habitus and, therefore, a truly deterministic perspective would necessarily lead us to some, at best, incomplete conclusions[12]. As an illustration, consider a jazz musician performing a solo. He may be constrained by the style of jazz he is playing but has the capacity to perform, creatively and perhaps uniquely, almost any combination of notes within that style.

Of Hilgers' (2009) three arguments, it is the second which most clearly refutes accusations of determinism in Bourdieu's work. The constantly changing nature of habitus means that social actions can become incorporated into dispositional tendencies. If, however, habitus is a constantly changing, highly individualised notion then does class analysis have anything to lend to overall analysis of societal structures and their reproduction? I argue here that it does by suggesting that, although individual actions can be incorporated into an actor's habitus, in actuality, groups of people of the same class have strikingly similar patterns of behaviour and dispositions which have been generated by their similar experiences in life.

Distinctions between social classes

Bourdieu (1984) suggests that it is 'differences in cultural capital [that] mark the difference between the classes' which, perhaps, unintentionally implies that levels of social and economic capital do not alter a person's habitus. I would suggest that these differences in levels and composition of different capitals are useful for distinguishing between classes. Bourdieu's (1986) emphasis on cultural capital in the previous quotation downplays the potential effects of other types of capital, such as social capital, in maintaining or challenging class structures. Further, society is no longer structured in such a way where a high level of cultural capital leads to a job with higher status and, consequently, a higher class position. The expansion in higher education provision (in the UK and elsewhere) has, for example, led to high numbers of 'well-qualified' graduates chasing a diminishing number of graduate-level jobs (Curtis, 2008). In the educational sphere, as in the sphere of

[12] I include this third point to show Hilgers' (2009) complete argument but suggest that he may be collapsing real life with our understanding of it. So, the world may be determinist but we may not be able to understand it as such.

paid employment, individuals are encouraged to utilise all the resources available to them – whether these are economic, social or cultural. While cultural capital levels may have almost exactly mirrored the structural hierarchy of society in the past, the situation is now far more complex. In order to make sense of this complexity, we can view cases as configurations of different levels of capital and accept that we may see may see cases with very different levels of each type of capital behaving similarly (with respect to some chosen outcome) . For example, we could imagine a person with an exceptionally high level of social capital and low cultural capital obtaining a place on the same university course as a person with very high cultural capital and low social capital. An example such as this highlights clearly a feature of many social science outcomes – namely that there may be more than one 'route' to reaching them. By using Qualitative Comparative Analysis in my work, as I explain in Chapter 4, I can analyse large datasets with this principle firmly established and am not forced to accept the results of standard statistical methods which assume a 'net-effect' of a variable across all cases under study (Ragin, 1987).

The notion of habitus, which is informed by past events and shapes future behaviour, allows us to pick apart why some social trends or structures are reproduced through time. In the educational context, it allows us to explore parents' attitudes to their children's education and link this to the parents' own experiences of school. Crucially, I do not seek to give a full account of a person's habitus nor make predictive claims (and would argue that this is neither possible nor desirable). Instead, in each case, I look for evidence of which types of capital parents possess and whether those with similar compositions of capital have similar experiences when helping their children.

Types and forms of capital

Economic and symbolic capital

Bourdieu (1986) suggests that there are different types of capital – some of which are abstract and difficult to measure. Broadly, he expands on the Marxist idea of economic capital by adding another two categories, cultural and social capital (Bourdieu, 1986). Both of these are types of symbolic capital, showing that Bourdieu wants, in his schema, to account for Weber's idea of status. Bourdieu (1986) argues that symbolic capital is that which is 'unrecognized as capital and recognized as legitimate competence'. It is this form of capital, he argues, which 'presupposes the intervention of the habitus' as it is often mis-recognised as innate cognitive ability or skill (Bourdieu, 1986).

Social capital is a quantification of all a person's social connections. Bourdieu (1986) argues that membership in any kind of group grants access to a minimum level of shared capital in that group (those in a position of power within the group may have access to more than just the basic level). He suggests that all social ties are relevant when considering social capital whether the relationship is a formal one or an informal one (Bourdieu, 1986). Examples of social ties include those with family members, work colleagues or fellow members of a club. An individual's level of social capital does not just depend on the vastness of their social network, however, but also on the levels of capital possessed by those in that social network. For example, through social contacts, an actor may have access to even more social or cultural capital (or both). So, someone with just one contact, but one who has high levels of social and cultural capital, may reap more benefits from this one contact than someone with several contacts with low levels of capital.

Forms of cultural capital

Cultural capital is further divided into 'embodied', 'objectified' and 'institutionalized' states each conveying a subtle difference in how that type of capital is accumulated and how it can be transferred (Bourdieu, 1986). The embodied state encompasses 'long-lasting dispositions of the mind and body' and can be thought of as skills or attitudes (Bourdieu, 1986). The objectified state encompasses 'cultural goods' – actual objects (such as books) which represent theories or abstract ideas (Bourdieu, 1986). Finally, institutionalized cultural capital is a special form of the objectified kind which is usually indexed by some form of qualification[13]. Classifying a form of capital as institutionalized does require, however, some knowledge of the context in which that capital was acquired and the context where it might be used. In Chapter 7 and 8, I use Bourdieu's idea of 'field' to account for this context but, here, I note that what is considered institutionalized can change from one situation to another and over time.

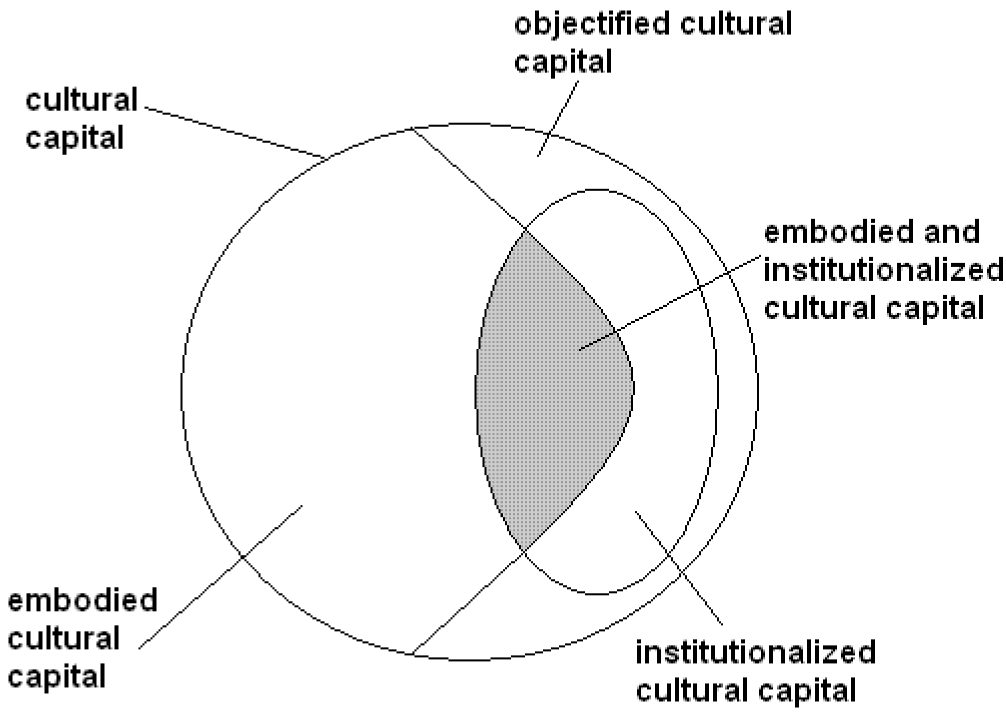
In Figure 3.1, I show how these three forms of capital relate to one another. Using the example of educational qualifications, as Bourdieu (1986) does, we can see how some particular forms of cultural capital become legitimized in society and incorporated into a hierarchy where they are compared and the relative value of each is assessed.

In actuality, I would argue that a person rarely possesses cultural capital distinctly in one or other of the above forms. Analysing a situation requires us to be open to the possibility that cultural capital is present in several forms even in a single action. We could imagine, for example, a sportsperson who spends hours training to perfect the physical movements necessary for his or her sport. This is certainly a form of embodied cultural capital because it creates a change in the physical movements of the individual (by making them stronger, for example) by altering dispositions and must be obtained first-hand by the person in question (someone else cannot become stronger for you). Now imagine that this person wants to correct another's technique. If they demonstrate and explain, they are using both embodied cultural capital (for the movement) and pedagogic capital for the

[13] Note here that I do not suggest that all those with institutionalized cultural capital will have the associated qualifications. We could imagine someone attending all the teaching sessions associated with a course and not sitting an exam. I contend that such a person still has institutionalized capital.

explanation. If, instead, a sports teacher corrects the technique then they could be using both embodied and institutionalized cultural capital.

Figure 3.1 - Forms of cultural capital



In a mathematics education context, someone who is truly skilled (in the same sense as the person described above is in sport) has altered their dispositions to think in a mathematical sense. They must also, of course be able to perform the practical tasks of writing and presenting their answers but the main dispositional alteration is in the mind, in this case. To prove, however, that you have a proficiency in mathematics, you must transfer this embodied cultural capital to the institutionalized form and obtain a qualification in mathematics. The exam taken to prove competence suffers from a structural inability to assess embodied cultural capital because it will contain questions on certain areas of mathematics and not others and must be completed within a set time.

I also draw the distinction here between different types of cultural capital in mathematics and the distinction made by, among others, Nunes et al (1993) and Bishop (1994) between formal mathematics and informal mathematics. For both these authors, the distinction between the formal and informal lies in the location of learning. For them, mathematics taught in a structured way, as in a school, is formal. This type of mathematics learning often leads to a qualification is almost always taught by an expert, the teacher, to the pupil. By contrast, informal mathematics learning is embedded in problems that exist in the world. Nunes et al (1993) analyses fishermen's understanding of proportionality which has been gained through their jobs. She compares the strategies fishermen use for solving problems of proportionality with those taught in schools for tackling similar, fabricated problems and finds that they differ.

Someone learning mathematical concepts informally, like the fishermen Nunes et al (1993) talk of, changes the way they work or perform a calculation as a result of this informal learning. This new knowledge is not, however, easy to quantify and is bound up in that person's understanding of the task at hand and is, therefore, embodied capital. I suggest the difference between formal and informal mathematics is not in the location necessarily but that formal mathematics learning gives the learner embodied capital *and* institutionalized cultural capital. In addition, we may expect formal learners and informal learners to tackle a problem in very different ways. I suggest that this is indicative of their two different habituses: brought about by differences in the levels and forms of capital they possess.

Having mapped Bourdieu's (1986) definition of cultural capital and the forms within it on to some specific theories from mathematics education, I can begin to create a framework for analysis in this piece that will allow me to categorise each type of mathematical knowledge depending on where it was acquired, how it was acquired and the dispositional change it has created (if any) in the learner. I suggest that, in order to categorise instances of possession of cultural capital in the interview data, we have to know how it was accumulated and attempt to analyse the effect on the bearer. Of course, it is impossible to measure dispositional change through a single interview but I attempt to tease out whether the different habituses shown by parents can be attributed to their levels and composition of capital. I hope that questions about, for example, whether or not someone uses mathematics (however defined) in their job will help me to do this.

Though this section focuses on mathematics education and so, inevitably, looks for evidence of mathematical cultural capital, I suggest that other types of cultural capital may make it easier or harder to acquire and/or transfer capital. These other forms of cultural capital are discussed in the abstract here as they may not be present in all (or any) of the cases I analyse later. In particular, I suggest that mathematical confidence and educational confidence, more generally, are types of embodied cultural capital which may affect how easy or difficult it is for a particular person to gain institutionalized mathematical capital. I also consider that linguistic cultural capital (either as an embodied form of cultural capital or as institutionalized cultural capital or a mixture of the two) can affect both the accumulation and transmission of cultural capital. Finally, I consider pedagogic capital (in both the embodied and institutionalized form) because, I argue, very low levels of this could hinder the transmission of mathematical capital form parent to child. By this I mean, the parent(s) may lack the specific knowledge of the curriculum (the institutionalized form) and/or the skills (the embodied form) to transfer their mathematical capital to their child.

Educational confidence

I suggest that educational confidence, generally, and mathematical confidence, specifically, are forms of embodied cultural capital because possession of confidence (of lack of it) is a disposition towards education. In keeping with the recently presented argument about the importance of examining the composition of capital, I suggest here that confidence must be viewed in conjunction with other levels of capital if we are not to over-emphasise its causal impact on the outcome of achievement.

In keeping with the emphasis on conjunctural causation throughout this thesis, I suggest that confidence levels are inextricably linked with other levels of capital and cannot be thought of as a separate causal factor. In psychology, confidence is often termed 'self-concept' and there has been a suggestion to move away from the use of general academic self-concept measures towards more specific ones which measure mathematical and verbal self-concept separately (Marsh et al, 1988). Marsh et al (1988) argue that there is a negative correlation between mathematical achievement and verbal self-concept and between mathematical self-concept and verbal achievement which justifies their treatment as separate constructs but I suggest that the way self-concept is measured, through multi-item instruments with closed questions, in Marsh et al's (1988) work (and in many similar studies in psychology) could be the reason for this finding rather than it representing an inherent relationship.

Marsh et al (1998) revised an earlier definition of academic self-concept by incorporating some other findings from psychological studies into their work. These were, principally, the finding by Byrne (1984) that academic achievement had a higher correlation with academic self-concept than general self-concept (which accounts for non-academic factors) and that, within that, self-concept scores relating to specific academic areas were more highly correlated with their corresponding achievement scores i.e. mathematics self-concept was most highly correlated with mathematics achievement. Though Marsh et al (1988) argue for this correlation as revealing a biological connection, Tan and Yates (2007) have suggested that it merely reveals a cultural dimension of Western education by using Singapore as a counterexample where this relationship does not hold.

Linguistic capital

Bernstein's (1964) descriptions of socio-linguistic systems include the distinguishing of, what he terms, 'elaborated codes' from 'restricted codes' of language. This is not a distinction drawn between different forms of vocabulary but, instead, confers a difference in the organisation of language and the meaning conveyed. For Bernstein (1964), an elaborated code allows a speaker to verbalise their 'discrete intent' with non-predictable patterns of speech and vocabulary because the speaker is using precise structures and vocabulary to convey a specific meaning – one that is hard to replicate exactly with another set of words or different structure. Use of an elaborated code indicates 'a higher level of verbal planning' on the part of the speaker (Bernstein, 1964). In contrast, use of a restricted code does not allow for the intent of the actor to be discerned because it is possible to predict what the 'syntactic alternatives' for the speaker are (Bernstein, 1964). Bernstein notes that a speaker using restricted codes may rely on the use of a more limited range of vocabulary but that we cannot assumed a restricted code is operating just from an examination of the words.

Bernstein (1964) argues that the use of either type of code should not necessarily be seen as a marker of intelligence but as an indicator of the 'social constraints' placed on the speaker when communicating to another particular actor in a particular social situation. I can see two useful applications of these ideas to my work and outline these briefly below (before returning to them in more detail in Chapter 4).

Firstly, I suggest that for parents who cannot communicate mathematical ideas using elaborated codes, transferring their knowledge of mathematics (from a work context or out-of-date school context) to their child will be very difficult. Using restricted codes instead could mean, for example, a reliance on the use of examples. Secondly, I suggest that the interactions parents have with their child's teacher may suffer from the same problem with parents unable to articulate the nature of the problem they are having with mathematics at home and, instead, resorting to naming specific examples of questions that were difficult.

Pedagogic capital

Finally, I consider pedagogic capital as indicating the degree of familiarity with the curriculum and teaching methods. Someone with a high level of pedagogic capital, such as a teacher, should be able to communicate complex ideas to another person. The concept of pedagogic capital, in a sense, collapses two separate ideas put forward by Bernstein (1977) as being important when considering teaching: curriculum and pedagogy. I choose to consider these as one construct because I conceive that a lack of knowledge of either curriculum or pedagogy constitutes a lack of knowledge of the formal processes of education in mathematics.

I examine later the strategies parents employ to overcome their own lack of specific knowledge of modern teaching methods, terminology or curriculum content and consider whether pedagogic capital is, in fact, necessary to provide effective help. There are two different types of strategy employed by parents in my study – increasing their own levels of pedagogic capital and accessing those who have pedagogic capital. I compare these and explore whether, even when levels of pedagogic capital increase, levels of other capitals remain too low to allow for effective help to be given.

Transferring capital

One of the key things I seek to examine in the thesis is whether the types and levels of capital possessed by parents enables or limits the help they give with mathematics. I frame the process of helping as one of transference of mathematical capital (in whatever form) from parents to their children. I examine whether children who attain well in mathematics must receive parental help and, using the interview data, whether the composition of capital within a parent can give clues as to *why* they have been able to (or not able to) help their child. Looking for different types of cultural (and later, social) capital should help me to distinguish between those parents who do not have relevant capital and those who have trouble transferring the capital they do have. In the 1970 Birth Cohort Study, the question about parental involvement was capturing a teacher's perspective and, since the two instances described above lead to the same outcome – namely capital not being transferred, it cannot help us to understand the manner in which a parent is involved (or not involved).

The problem, then, may not be one of distinct academic and practical capability but could instead rest on parents being able to exchange and transfer the capital they have in the most effective way. If there are barriers to this transfer, like prohibitively low levels of other forms of capital, a parent may not be able to help their child. One of the specific forms of other capital I suspect is crucial to successful transfer is, what I term, 'pedagogic capital'. This is another form of institutionalized capital which covers knowledge of the education system in general. This capital facilitates the transfer of embodied mathematical capital to institutionalized mathematical capital by increasing awareness of what constitutes institutionalized mathematical capital. It may manifest as, for example, a knowledge of the content of the curriculum – specifically, what is and is not expected to be known by a child at a particular stage of schooling. It may manifest as an understanding of systems of assessment in place and what the implications for future learning are of a child's result in a test. Possession of high levels of this pedagogic capital allows parents to provide help consistent, in mathematics, for example, with the methods employed at the school. In some cases, parents with high levels of pedagogic capital may challenge the school and argue that a teacher is not meeting their expectations.

In some pieces of research which examine parental relationships with schools, parental intervention of the type mentioned above, coupled with demographic information, is taken as evidence that middle-class parents are more confident in challenging teachers (Crozier, 2000). I suggest that parents are more confident when they possess high levels of institutionalized capital which allows them to challenge the school or address a problem with reference to very specific elements of the curriculum, for example.

As well as pedagogic capital, I contend that linguistic capital is required if a parent is to approach a teacher as the parent must be able to articulate the problem. Linguistic capital can exist in the form of institutionalized capital and, taken in an educational context, this form is the vocabulary of associated with particular subjects and stages in schooling. Mathematical institutionalized linguistic capital is a separate form because often words used in a mathematical context will take on a different meaning to the meaning they hold in general parlance. I suggest that there is also an embodied form of linguistic capital, in education generally and mathematics, more specifically.

So, while levels of capital are a good clue to how well a parent can help, it is the composition of capital in a parent that allows them to transfer capital from one type to another, to know what knowledge is most effective to pass on and to be able to transfer the capital to the child. This echoes Lareau (1989) who talks of parents from different class backgrounds having 'different resources' available to them when they want to help their children. She found that parents expressed a desire to help, whatever their class background or resource level, but those with the appropriate resources were the most able to help (Lareau, 1989). While this may seem like an obvious conclusion, we should remember that, from a teacher's perspective, a lack of help from parents may be interpreted as a lack of desire to help.

<u>The problem with institutionalized capital</u>

Furthermore, since, for example, the content of the school curriculum can change over time (as I showed in Chapter 1), the institutionalized version of mathematics is not stable over time and is sensitive to changes in government and trends in educational research. In fact, the universality of mathematics in general is an idea challenged by many (D'Ambrosio, 1985). The most developed attack on the mathematics canon comes from those working in the field of 'ethnomathematics'. Scholars in this field typically challenge the 'eurocentrism' present in school mathematics by claiming that western European representations, theories and notation are given unfair prominence in school mathematics (Powell & Frankenstein, 1997). Not only can this lead to a skewed public perception of what constitutes mathematics, it can also marginalise students from ethnic minorities as there is nothing taught which draws on scholars who share their cultural background, despite this being available to teach. An example of this is 'Pascal's triangle', named after the French mathematician Blaise Pascal who represented and calculated the coefficients in a binomial expansion using a triangle of numbers which he published in 1663. The name 'Pascal's triangle' is given to this despite Pascal not being the first to establish the relationships between binomial coefficients (this is thought to be in a 10th century Indian work) or the first to create a diagrammatical representation of them (Swetz & Kao, 1977). The first was, in fact, the Chinese mathematician Yang Hui and, accordingly, it carries his name in China (Swetz and Kao, 1977).

Legitimacy in schooling is not, however, only given to those theories and representations which concur with the dominant ethnic group's interpretation of the history of mathematics. When institutionalized mathematical capital is transmitted through an objectified form of cultural capital – the curriculum – there can be a class bias. Atweh and Cooper (1995) suggest that working-class pupils' constructions of mathematics may differ from that of their teachers. The teacher, however, represents the official version of mathematics and so children in this position have to reconstruct their views about mathematics to fit with those of the teacher (and the material taught) in order to be successful. It is in this way that 'problem solving' exercises in mathematics are slightly misleading as they claim to require an extension to the purely institutionalized form of mathematics by asking a pupil to apply their knowledge to an unfamiliar situation. Whenever this asks for a piece of 'real-life' knowledge, those children whose habitus is most closely aligned with the institution setting the question are going to be able to, almost instinctively, know what is being asked of them. These children, provided they also possess a high enough level of institutionalized mathematical capital to be able to answer the question, will be at an advantage (Cooper & Dunne, 2000).

The above position fits with Lubienski's (2000) work on problem solving in mathematics where children of a lower socio-economic status (SES) faired less well than their higher SES peers. In her study, she notes that children from higher SES backgrounds were more confident with the tasks and seemed to ascertain what the question was asking them to do mathematically more frequently than their lower SES peers (Lubienski, 2000). I argue, in agreement with Cooper and Dunne (2000) that this increased confidence is part of a class habitus associated with intermediate- and PMT-class children since these children are more dispositionally aligned with the dominant culture and, in particular, have 'real-life' knowledge which is more similar to the institutionalized 'real-life' knowledge they are asked to bring to mathematics problems.

What is clear from the above, then, is that the mathematics taught in schools is a selection of what can and should[14] be taught and so success in school mathematics (a form of formal mathematics which transmits institutionalized cultural capital) may depend on more than just the levels of institutionalized cultural capital the child has. In school mathematics, there is an institutionalized bias towards the dominant culture (in whichever country is under consideration) and towards the dispositions and values of intermediate- and PMT-class people. In other words, the transfer of institutionalized mathematical capital is a biased process as well as the content of the curriculum being biased. As Bernstein argues, the processes of curriculum formation and delivery, pedagogy and assessment all favour those children from higher social class backgrounds (Bernstein, 1977).

[14] As argued by differing stakeholders such as employers, parents, teachers and, perhaps, children.

Social capital

Social relationships are, in a sense, limited by the geographical location of the social actor in question and also the levels of economic and cultural capital he or she possesses. While we can actively search out and foster relationships with those we assess as useful to us, those people with wealthy or well-connected families may not have to do this. They will ordinarily have access to other wealthy or well-connected individuals from their original family ties. It is in this way that social capital can have a multiplying effect on the economic and cultural capital already possessed by an individual (Bourdieu, 1986). Conversely, someone with very limited economic or cultural capital (or both) may find it difficult to cultivate the type of contacts that the person mentioned above would meet in his or her everyday life.

These two examples are, of course, two extreme situations and many people will have social relationships with others who have a variety of levels of cultural and economic capital. The idea of a multiplying effect is important, however, for explaining why just one contact can make a great deal of difference when parents attempt to help their children with mathematics. A parent who works in a school, for example, may know a mathematics teacher who can provide the specific help required. I contend that the most useful social contacts a parent can have in the mathematics education context are those who link the parents to greater levels of up-to-date institutionalized cultural capital and pedagogic capital.

In fact, a social contact is only going to prove useful in any educational context if they can provide (or have access to) additional capital to that of the parent(s) and can transfer this to the child[15]. Unsuccessful attempts to transfer cultural capital from a social contact to the child may be disrupted for similar reasons to those which stop transfer between parent and child (lack of pedagogic capital etc). There may be another reason, however, why parents

[15] Except in the circumstance where parents have a suitable level of capital but not the time or inclination to provide help.

who seek out social contacts in order to help their children with mathematics find that this has been an unsuccessful exercise. Selecting someone to help from a wider social network requires some assessment of that person's capabilities and their potential ability to help. In order to make this assessment successfully, the parents themselves need some minimum level of up-to-date institutionalized capital (in the form of pedagogic capital) in order to know what exactly the child needs help with. Further, they must have some understanding of the capital required to overcome this difficulty. If they select someone, for example, with a high level of embodied capital but very low levels of linguistic capital, this person may struggle to transfer their embodied capital to institutionalized capital and then transfer this to the child. One of the biggest misconceptions about institutionalized capital becomes important in this context – namely that institutionalized capital is timeless: that is to say, institutionalized capital gained at any point in the past could be considered institutionalized capital at any time in the future. Since institutionalized capital reflects what is considered an appropriate level of knowledge by the dominant culture at a specific point in time, it only retains its status at institutionalized cultural capital in the future if the dominant culture or its interpretation of what is appropriate knowledge is does not change. Bourdieu (1986) is correct to say that institutionalized capital, in the form of educational qualifications, confers a 'legally guaranteed' form of cultural capital and, certainly, once an educational qualification is gained it cannot be removed from its bearer.[16] However, I argue that older forms of educational qualifications lose value over time if there is significant change in the curricula from which they derive. In the case of mathematical qualifications, as we have seen, the curriculum has changed significantly since its inception and continues to do so. This, I argue, devalues some older forms of institutionalized cultural capital to such an extent that they cannot be considered institutionalized capital any more.

[16] Except in exceptional circumstances where someone has been found guilty of cheating or plagiarism. I exclude this possibility here.

I want to be clear that I am not suggesting embodied mathematical capital is invariant over time. In fact, it is possible to see that all forms of cultural capital are susceptible to erosion over time. As with any skill, embodied mathematical capital can degrade if the social actor with whom it is associated does not make efforts to re-acquaint his- or herself with mathematical activity. The same is true for institutionalized mathematical capital – if a social actor never looks at his or her mathematics textbook again after leaving school, their knowledge of what they had learned may diminish. I contend, however, that even if its levels did not diminish with time, the very nature of institutionalized mathematical capital changes over time. This is because what counts as mathematical knowledge, in an institutionalized sense, changes over time.

Note that I am also not arguing here that these older forms of institutionalized capital are value-less but instead that they require translation into up-to-date institutionalized cultural capital if they are to be transferred most effectively to a struggling child. As I have argued elsewhere in this section, transferring capital from one form to another often requires additional levels of capital. In the case of mathematical qualifications, someone with an older form of qualification must have some knowledge of the current educational system and the mathematics curriculum if they are to transfer their capital to up-to-date institutionalized cultural capital. This knowledge need not be extensive, however, and may be gained from dialogue with the child they are trying to help (requiring a certain level of linguistic capital) or from consulting a textbook (and thus having access to objectified capital).

It is because a working knowledge of the modern mathematics curriculum is so crucial that useful social contacts for a parent can turn out to be older children. I explore this idea in the analysis of interview data to see whether parents with older children have been able to learn about the curriculum and modern methods from their older children and, thus, increase their levels of pedagogic capital over time.

Summary

Pulling apart the different types of capital an individual has allows me to move past obvious assumptions that a high level of mathematics qualification is sufficient to help a struggling child or that those with no such qualifications will find it impossible to help. I contend that there must be some balance between academic knowledge of mathematics and practical skills in communicating this knowledge to a child. Further, the use of a curriculum in schools means that only a portion of mathematical knowledge is taught and tested which introduces a large element of selectivity into the formal version of the subject. By this I mean, someone has decided what to include and exclude and the elements which are included are thus given an air of legitimacy and come to represent what constitutes mathematics for a child at that particular stage of schooling.

Bourdieu (1986) is careful not to perpetuate the practical/academic divide by noting that embodied cultural capital alters dispositions of the mind **and** body. He separates institutionalized capital into its own type because of the more direct rewards that come from possessing it. In a sense, this analytical framework allows us to distinguish whether small amounts of the ‘right’ type of capital lead to greater social and economic rewards than greater quantities of other types. In the specific mathematics context, a parent with purely embodied mathematical capital may be able to transfer that to institutionalized capital before transferring this institutionalized form to their child. The difficultly with trying to transfer embodied cultural capital is that, as the name suggests, it is tied up in the person and must be converted to another type. If parents are unable to transfer this embodied capital to institutionalized capital, they may, instead, choose to acquire cultural goods (objectified cultural capital), such as books, to help their children but this also depends on having sufficient economic capital to do so.

Chapter 4 – Research Design

I have discussed in Chapter 1 some of the consequences, both historical and contemporary, of doing well in mathematics and shown how mathematics has come to have a prominent place in the school curriculum. I suggest that, because of its wider social consequences, access to mathematics is an important area of research to consider. The hierarchical nature of the school curriculum means that a solid grounding in formal mathematical concepts in primary school is important for progression to national examinations and beyond.

With schoolwork in general, most parents want to help their children and I suggest that the high-stakes nature of mathematics only increases that desire (DfES, 2003).   What is less clear, however, is what the best type of help to give is and whether helping will have any impact on attainment. A limitation of some previous work in the field of parental involvement is the assumption that parents are a, more or less, homogeneous group and that parental involvement, in whatever form, from any parent will impact positively on attainment. Some useful work exists in the sociology of education about different types of parents and the differing help they give and I draw on this to highlight some of the additional complexity that may be present when studying the effects of parental involvement in mathematics. In Chapter 2, I show that the perception of mathematics as a subject of absolutes leads to a privileging of official, formal methods of calculation and knowledge and excludes some more applied knowledge and skills by dismissing these as incorrect.

In Chapter 3, I propose a name for such official knowledge – institutionalized capital. Drawing on Bourdieu (1986), I develop a theoretical framework based around levels and forms of cultural capital. I suggest that social class position can be conceived in terms of levels of capital and that a person's actions may be influenced by these levels of capital through their habitus. So, for example, parents with differing levels of cultural and social capital may have different strategies for helping with school mathematics. In particular, those parents with high levels of institutionalized capital may be in a better position to help their children.

In order to investigate whether it is the case that some parents' help is more successful than others and that different parents are differently able to help, I pose the following broad questions:

- Is parental interest sufficient for attainment in mathematics for some children and not others?
- Do parents of different social classes provide different types of help in mathematics?

I choose a mixed-methods approach to help me answer these questions and analyse two different datasets. To answer the first question, I conduct case-based analysis on a large, longitudinal dataset. I use the 1970 British Birth Cohort data (hereafter, BCS70) and examine, firstly, which configurations of the factors general ability, sex of the child, parental involvement and social class lead to various levels of mathematical attainment for the respondents of the BCS70, when they were aged 10. I then build a similar model for the children of the respondents and compare these two time periods.

The method I use to do this is the innovative, case-based method QCA which is gaining in popularity in social science but is still an uncommon approach in educational research and for analysing large-n datasets more generally. In Chapter 5, I particularly concentrate on, in the latter part of the chapter, some of the methodological challenges using QCA presents and these are relevant to the results I then present in Chapter 6.

I aim to see, using QCA, whether parental involvement is impacting on attainment in mathematics for some children and not others. Types of children are represented in the QCA model as configurations of factors and a case-based approach, such as QCA, allows me to treat these configurations as whole entities thus avoiding the assumption of average, or net, effects of single variables. This is a key way that my work differs from previous work on parental involvement using large datasets. Often, work such as this will search for the unique contribution of a single variable (or combinations of variables) and I suggest, as does Ragin (1987), that this ignores the possibility that a variable may act on one case differently than it does another.

Following on from the QCA results in Chapter 6, I address the second question posited earlier, namely, 'Do parents of different social classes provide different types of help in mathematics?' I select some interview participants so that their characteristics match that of certain types of interest in the analysis. I particularly focus on interested parents from working-class or intermediate-class families with either children doing very well in mathematics or children who are struggling. Within this group, I examine those with links to the teaching profession as they have greater institutionalized capital and so may be able to provide more successful help. In practical terms, I interviewed parents to ask them questions about the parental help in mathematics they received as children. I also asked them to detail what strategies they used to help their own children with mathematics. I aim to use these interview data to try to pick apart and identify in what ways the type of help being offered by parents (or through their social networks) differs by social class.

<u>A typological approach to analysing parental involvement in mathematics</u>

The sampling strategy in this study was to select participants based on a variety of attributes so that they would possess similar characteristics to the examined cases in BCS70. Since it was not possible here for me to contact actual participants from BCS70[17],

[17] As part of the 'acceptable use condition' for use of BCS70 data, I was not permitted to identify individuals from the dataset. Such qualitative work has been carried out by Elliot et al (2010) by tracing individuals from the National Child Development Study (NCDS), the precursor to BCS70, which follows a cohort born in 1958.

I considered the QCA process as creating a typology and showing which types of families had, for example, children who attained highly in mathematics. I selected interview participants to map on to some of these types so that I could relate the data from their interviews back to the results from BCS70. As I explain in Chapter 5, my working notion of typology is akin to the idea of 'attribute space' developed by Lazarsfeld (1937) . The basic premise is that a (non-exhaustive) list of attributes can be thought of as dimensions for the field under study and that cases sit within this field – their placement determined by their configuration of attributes.

By matching my interview participants with types in BCS70, I link the detailed analysis of levels of capital within-cases with a broader, cross-case analysis. By constructing my typology in this way, I avoid some pitfalls commonly associated with typology creation in social research. Kluge (2000) suggests that, although typologies and their associated types are commonly used in social research, attempts to create typologies are often not systematic and/or the reasoning behind their creation is not made explicit. Using QCA results as the basis for a typology not only provides a systematic approach to typology formation but also ensures that any typology has an empirical grounding which allows for more and less likely configurations to be identified at an early stage.

Finally, this approach to typology formation is consistent with viewing cases holistically and seeking an explanation for the different outcomes achieved by different actors. As Glaesser and Cooper (2011) note, some sociological explanations of social class differences in education focus less on differences between social actors and more on their decision-making process as rational actors. An account which suggests, as this study does, that differing dispositions are to be found in the different social classes must work from, what Glaesser and Cooper (2011) term, an 'actor-centred' perspective. Bourdieu's ideas on habitus present an explanation as to why dispositions may differ which is grounded in the analysis of differing levels of capital in actors. Taking a case-based approach to the large-n and small-n parts of this study means that casual pathways and processes can be examined at both the micro- and macro-level within this actor-centred framework.

From a typology to a within-case analysis

The factor ‘social class’ is, as Flude and Ahier (1974) a ‘summarising variable’ for differences in attainment between children. I suggest that ‘social class’ acts, here, as a summarising variable for levels of cultural capital but that it is reasonably crude and does not allow me to investigate, for example, the different types of capital that may be present. The factor ‘parental involvement’ is particularly crude because, as we have seen in Chapter 2, involvement can take many forms: some of which are more successful than others in leading to high attainment. In Chapter 3, I suggested that a reason for the different acts of involvement and the differing effects of involvement on attainment could be explained by levels of capital present in parents. Since I also contend that high levels of particular capitals examined in Chapter 3 are more commonly present in parents with a higher social class background, it is sensible to include social class position as a summarising variable for cultural capital, in conjunction with parental involvement and other factors, to determine if involvement from parents in higher social classes produces higher attainment than that from parents in lower social classes. I need the associated interview data to investigate levels of particular capitals and configurations of capitals present in parents. This, I suggest, will allow for an explanation of *why* the involvement of some parents leads to high attainment.

Bourdieu (1984) suggests that different classes have access to different types of capitals and that the possession of some types of capital is more normally rewarded in an academic capacity. I look for evidence of different types of capital among the parental interviews and examine how that capital is transferred and exchanged. Bourdieu (1984) also suggests that social structures are maintained through the unequal distribution of capitals in society. I examine a facet of this claim by exploring whether the same class distinctions are present in an analysis of the BCS70 cohort as parents. I conduct QCA using comparable factors from two different sweeps of BCS70. I introduce, here, a convention that I will use throughout to distinguish between different generations. I term the respondents of the BCS70 as ‘Generation 1’, their parents as ‘Generation 0’ and the respondents’ children as ‘Generation 2’. So, when I compare QCA results for the BCS70, the first set of results focuses on Generation 0 helping Generation 1 and the second set focuses on Generation 1 helping Generation 2.

The results obtained from this second analysis do differ from the first QCA results and I offer some theoretical explanations as to why this might be combined with some more evidence from the interview data. I view this research design as a cyclic process which could continue with a great number of refinements and re-analyses of data. The original model used in the QCA of BCS70 contains factors that I thought to be causally relevant, based on an explanation of parental involvement in terms of capitals. I do not claim that this model contains (or can contain) all the causally relevant factors that exist and, instead, suggest that the interview data could pinpoint specific factors that warrant inclusion into a refined version of the model. Further, because QCA is concerned with finding which configurations (or types) most consistently achieve the outcome under study, it is possible to treat cases which do not behave in the expected way, not as errors but as cases where an additional, as yet unaccounted for factor, is having an effect.

Summary

I have argued that, because of their differing levels of capital, parents may be differently able to help their children with mathematics. I suggest that, particularly those with access to institutionalized capital, may be in an advantageous position compared to other parents without it. I propose that I can investigate whether, for some children and not others, it is enough to have an interested parent in order to attain highly in mathematics. In addition, to explore whether and why levels of capital do make a difference to the type of help given by parents, I interview some parents who match specific types I am interested in as a result of the findings from the analysis discussed above.

By using a combination of QCA and detailed analysis of interview data, I am able to analyse a large-n, longitudinal dataset whilst adhering to the principles of case-based research. Matching interview participants to types in the QCA allows me to investigate, in more detail, the causal processes at work in particular cases and use any findings to explain what is found in the QCA. This mixed-methods approach fits well with the theoretical framework for analysis I employ in the study – namely an explanation of parental involvement in mathematics education based on differing levels of capitals in parents. I see the QCA as a way of ascertaining which cases might be interesting to study and the analysis of interview data as providing causal explanations as to why some of the QCA results may have occurred.

Chapter 5 – Qualitative Comparative Analysis (QCA)

In this section, I explain what QCA is by exploring its underlying principles, associated notation and how it can be used to organise and analyse data. Particularly, I explain, in a chronological way, the different analytical stages necessary to conduct QCA and discuss, where appropriate, how these are similar to and different from standard techniques. I then present some QCA results from the BCS data and discuss some particular methodological challenges which arose during analysis. Using examples from the BCS data, I then explore some solutions to these challenges and discuss some alternative approaches advocated in the literature.

The theoretical ideas behind QCA

QCA was originally developed, by Ragin (1987, 2000), to analyse small- to medium-n datasets but he, and others, have used it to analyse successfully large-n datasets (see Ragin, 2006a; Cooper, 2005; Cooper and Glaesser, 2008). I use it here on a large-n dataset, the 1970 Birth Cohort Study (BCS70), because I want to be able to make cross-case comparisons based on a large number of cases. I suggest that QCA offers a fruitful way to do this without having to resort to assumptions about the independence of potential causal factors or the linear-additive nature of combinations of these factors.

A central assumption of methods dealing with conjunctural causation is that causes do not act independently (Cooper and Glaesser, 2008; Thomson, 2011). Much of the previous empirical work in my field, parental involvement in education and attainment inequalities, proceeds using regression-based methods. Research in this vein will typically involve looking for correlations between levels of parental interest and children's achievement or searching for common attributes of different parents who have high levels of interest in their children's schooling (see, for example, Bakker, Denessen and Brus-Leven, 2007; Domina, 2005; Friedel et al, 2007; Hirata et al, 2006).

Standard statistical methods which look for the unique effects (Desforges, 2003) of parental involvement to, say, attainment assume, in the first instance, that a unique contribution can be found and searching for it is helpful to analysis. Statistical methods require the use of, what Ragin (2006b) terms, 'net-effects thinking' and focus on analysing the effect of one variable independent of the values of other variables. This also means it is not possible to draw a qualitative distinction between cases that differ by, for example, only one variable in a model[18]. To pick apart our cases into their constituent variables[19] is contradictory to the theoretical framework being used in this study (as outlined in Chapters 3 and 4) and is an unhelpful way to search for complex causal processes.

Work investigating parental involvement using broadly case-based methods usually consists of analysis of interview data. Reay (1998a) interviewed a sample of mothers to explore how their social class background influenced the type of help they were able to give with homework and Crozier (1999) interviewed parents to ask about their relationship with the school. Both these pieces of work, typical of those in this vein, provide a detailed account of the differences in the type of involvement engaged in by different parents but steer away from discussions on attainment.

In QCA, we think in terms of sets and hence categorise our outcome measure as a set and all of the factors in the model as sets (Ragin, 1987). Each case, then, has a degree of membership in each of the factor sets and in the outcome set. In the crisp context, these membership scores are either 0 or 1 to represent either full non-membership or full

[18] In the field of parental involvement in mathematics, we could imagine that a working-class boy with an interested mother and a working-class boy with a uninterested mother get the same high score on a mathematics test. Despite their identical test marks, in a case-based approach, we are free to interpret these as two very different results if we suspect a theoretical link between high parental interest and test scores.

[19] In QCA, configurations of 'factors' constitute a case and a case is not decomposed into these at any point in the analysis. The focus is on how cases in their entirety behave, thought the effect of changing one condition on the outcome experienced by a case comprising an otherwise unchanged configuration of factors might be an important focus in some contexts.

membership in the set (Ragin, 1987). In the fuzzy context, the membership scores can take any value from 0 to 1 (Ragin, 2000). QCA users have developed the convention of capitalising the name of the relevant set to show cases which are in that set and using lower case to show the cases which are not in it. For example, if we take the set of men and name that set 'Male', then 'MALE' represents those in the set (i.e. men) and 'male' represents those outside the set (i.e. women). Often, sets are constructed for theoretical or practical convenience during analysis and the naming of them reflects this. If, for example, we wanted to conduct a piece of research about female educational attainment then it may make more sense to consider the set of 'Women' so that the results of the analysis appear in terms of 'WOMEN'/ 'women' and not 'male'/ 'MALE'.

Key differences between QCA and standard methods

Ragin (1987, 2000) suggests that the key difference between QCA and standard statistical methods is taking the case, as a whole, as the unit of analysis and seeing it as a configuration of set memberships and not a collection of separable variables. Taking this view allows us to interpret the same outcome, in two different cases, as qualitatively different. In an educational context, where general ability (measured using a standardised test) and previous mathematics attainment are taken as possible causal factors and a new mathematics test forms the outcome measure, we could interpret the same test score on this mathematics test differently for different cases. Standard statistical methods do allow us to control for factors which we posit may be affecting the outcome but there is no way to account for the qualitative difference between cases which score the same (or very similarly) on some outcome measure (Ragin, 1999). By this I mean, regression methods privilege use of 'independent variables' which, are estimated as the net-effect of several other variables and trying to account for the 'context' of particular cases contradicts this practice (Ragin, 2000). In a regression-type analysis, a case is a collection of variables and each variable can be controlled for and entered into an interaction term but the fundamental problem with this type of research is that it does not allow us to view cases holistically and account for their composition as several intertwined factors. Taking a configurational approach, instead, allows us to think of each logically possible configuration of factors as a type of case. As I show in later examples, not all logically possible types are likely to occur in real data.

Instead of assuming homogeneity of populations or trying to measure the effect of one characteristic across all cases, I re-frame the discussion of parental involvement to focus on cases and the potential causal factors within a case. Whereas a researcher working with variables and regression techniques would expect their variables to act in a uniform way across all cases, case-based researchers expect their qualitative factors to interact with other factors in the case (Cooper & Glaesser, 2008). Since each case in my analysis represents either a child, parent or family, seeing the case as a whole must be an important part of the research philosophy.

If we accept the principles above, namely that a case should be considered holistically, then, in order to make any cross-case comparisons, we must have a way of assessing which cases are similar or different to one another. A good starting point is to map out all the logically possible configurations of set memberships for a particular model. For crisp sets, this is relatively simple as set memberships are dichotomized into in or out of the set.

A shared feature of QCA and standard methods

Both conventional methods and QCA can be used to provide summary descriptions of the regularities (or partial regularities) that characterise the social world. In the case of correlational approaches, it is generally accepted that one cannot move simply from a correlation to a causal claim. Some of the literature employing QCA has tended to avoid the parallel problem that arises in moving from Boolean descriptions of regularities to causal claims. The position I take in the thesis is one I share with two colleagues at Durham (see Cooper and Glaesser, 2011; Glaesser and Cooper, 2011). This is that within-case data collection and analysis is required alongside the cross-case QCA analyses in order to provide access to the generative mechanisms and processes that produce the regularities described via QCA. It is via such an approach that it is possible to move from predictive knowledge to causal knowledge (see Hedström and Ylikoski, 2010).

Typological thinking in QCA

As mentioned in Chapter 4, it is helpful to think of all the logically possible combinations in our model as representative of types of cases. It is important, here, to be clear about what I mean by 'type'. Ragin (2000) suggests that 'types' in social science are often formed from a variable-oriented approach such as cluster analysis where cases are grouped together algorithmically by matching them on several attributes. The aim of a process like this is to see the types as 'emerging' from the data and having as little within-type variance as possible whilst, at the same time, maximising the variance between types (Ragin, 2000). In a sense, a balance must be struck between within-type variance and between-type variance and this balance is decided by the researcher according to his or her particular needs. So, despite the aim, types do not emerge from the data but are, instead, created from it. Ragin (2000) contends that the creation of types in this way can lead to arbitrary groupings which make little qualitative sense as types.

Type formation in QCA is, instead, is akin to Lazersfeld's idea of a property space (Ragin, 2000). Lazerfeld (1937) suggests that types should be thought of in their entirety as 'special compounds of attributes'. The terminology Lazarsfeld (1937) uses to describe types is deliberately mathematical as he intends to evoke a mental picture of how types could be mapped out. He uses the term ‘attribute space’ to refer to area in space occupied by the various attributes under consideration at any one time.

For example, if we want to consider two attributes at once, the related attribute space will be a two-dimensional one. Such a graph is a representation of where cases sit in relation to one another based on their values on two specified attributes. For n-attributes, the attribute space would be n-dimensional. Instead of representing attribute spaces of three or more dimensions diagrammatically (which is, anyway, impossible for four or more dimensions), it is more usual to formulate a table showing the various possible combinations of attributes.

Lazarsfeld (1937) gives the simple example containing three attributes – possession of a college degree, ethnicity (operationalized as white or not white) and being native born – and creates a table mapping out the resulting attribute space (which I have reformatted as Figure 5.1 below). To make sense of this table, we interpret a ‘+’ as having the attribute and ‘-’ as not having it. So, combination number 1 represents a native born, white person with a college degree. What Lazersfeld (1937) explains so well is how to simplify (based on theoretical knowledge) this kind of table into a refined typology with types which incorporate a wider range of attributes. We could suppose, as he does for illustrative purposes, that if non-white ethnicity is the biggest disadvantage then combination numbers 3,4,7 & 8 form, together, a type of the most disadvantaged. Next, looking only at white people, he proposes that being native born is the biggest advantage in this group and creates a type from combinations 1 & 5 and another from 2 & 6. He then argues that education may be important among native born white people and so considers combinations 1and 5 to be separate types. Thus, he has created a typology – one type comprising combinations 3,4, 7 & 8, one type comprising combination 1 only, one type comprising combination 5 only and one type comprising combinations 2 & 6.

Table 5.1 Table showing all possible combinations of the attributes 'college degree', 'white' and 'native born' (from Lazarsfeld, 1937)

Combination number	College degree	White	Native born
1	+	+	+
2	+	+	-
3	+	-	+
4	+	-	-
5	-	+	+
6	-	+	-
7	-	-	+
8	-	-	-

His example does not have an outcome measure or reference any specific theories but, instead, clearly shows the process of simplifying a typology which originally had eight types into one with four types (Lazarsfeld, 1937). Note how this differs from the statistical processes mentioned earlier which would group together clusters of cases in real data and separate them from other clusters without necessarily paying attention to qualitative similarities or differences. Lazersfeld (1937) maps out the possible combinations of attributes and then simplifies these into fewer types which correspond to theoretical statements because, he suggests, it is important that the types themselves make sense holistically.

Table 5.2 Simplified typology based on Table 5.1 (from Lazarsfeld, 1937)

Combination number(s)	College degree	White	Native born
1	+	+	+
2 & 6	either + or -	+	-
3, 4, 7 & 8	either + or -	-	either + or -
5	-	+	+

The fs/QCA software produces tables resembling Table 5.1 but, instead, represents the presence of a factor with a '1' and the absence of it with '0'. These tables are called truth tables and an example of one is given below in Figure 5.3 (from Thomson, 2011). In Figure 5.3, and all other tables, consistency figures are given to 2 significant figures.

Table 5.3 Example of a Truth Table

A	**B**	**C**	**number of cases**	**consistency with sufficiency (here, proportion achieving the outome)**
1	1	1	450	0.89
0	0	1	691	0.82
1	1	0	370	0.76
1	0	0	114	0.73
0	1	1	16	0.72
1	0	1	349	0.58
0	0	0	208	0.47
0	1	0	84	0.12

All possible configurations of factors A, B and C are shown here and the column labelled 'number' indicates the number of cases with each configuration of factors. The 'consistency' column is an indicator of how many cases in a row achieve the outcome in question. When working with crisp-set QCA, as I do here and throughout the thesis, this consistency measure is simply the proportion of cases of that row achieving the outcome (and, hence, must be a score between 0 and 1). A consistency score of 1 would indicate that all cases in that row achieve the outcome and a score of 0 would indicate that none do. In Table 5.3, as with all other truth tables throughout, I have ordered the table by consistency so that it is easier to see which are the rows with the highest consistencies. I discuss how to interpret such consistency scores below.

Having equated configurations of factors with theoretical types, it is now possible to analyse if those configurations (and their associated types) achieve whatever outcome we are studying. I want to be able to ascertain which configurations of factors (or single factors) are always present when the outcome is achieved or which configurations (or single factors) seem to be bringing about the outcome, whatever values other factors in the analysis take. Note that this approach is not the same as examining a case as a collection of variables. As Miles and Huberman (1994) suggest, a strength of QCA is that it allows researchers to analyse parts of cases without abandoning the idea that cases are whole entities.

Set-theoretic necessity and sufficiency

In order to examine whether a factor (or combination of factors) is always present when the outcome is achieved or is enough for the outcome to be achieved, I need a set-theoretic notion of sufficiency and necessity. It is important to note that configurations (as well as single factors) can be necessary and/or sufficient and so the process of calculating indices for necessity and sufficiency can be quite complex. In some cases, a factor (or configuration) may be a necessary *and* sufficient condition and, in others, it may be neither necessary nor sufficient.

Instead of searching for the effect of an independent variable on a dependent variable, as in regression analyses, QCA allows us to search for necessary and sufficient conditions for the outcome. The ideas of necessity and sufficiency in QCA are, in their most basic form, drawn from Mill's (1967 [1843]) methods of agreement and difference.

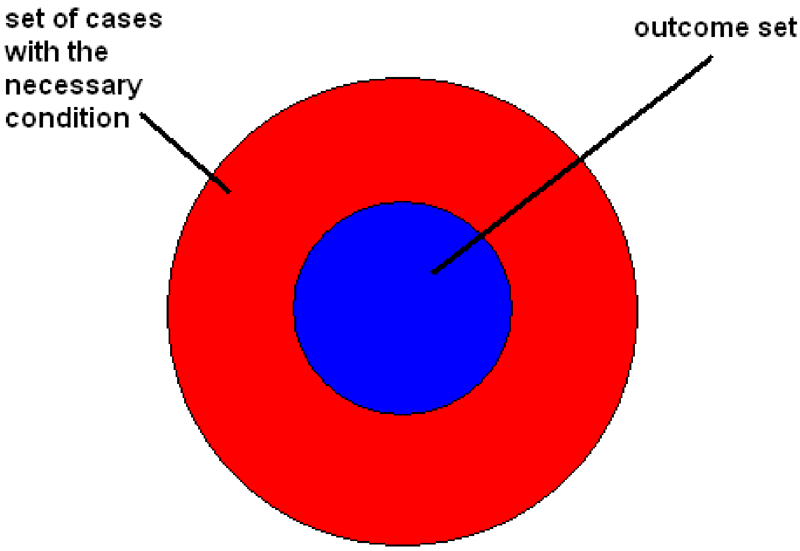
Necessary conditions

Of Mill's (1967 [1843]) methods, it is the method of agreement which is aligned to the idea of necessary conditions in QCA. Mill (1967 [1843]) describes this method as:

"*If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon.*"

As I explained above, necessary conditions can be configurations of factors and so the method of agreement can be repeatedly applied to find these. So, a necessary condition for an outcome must, as the name suggests, be present for the outcome to be achieved but may not *solely* be enough for the outcome to be achieved (Ragin, 2000). Figure 5.2 is a diagram of a perfect necessary condition where all the cases with achieving the outcome are contained within the set of cases with the necessary condition.

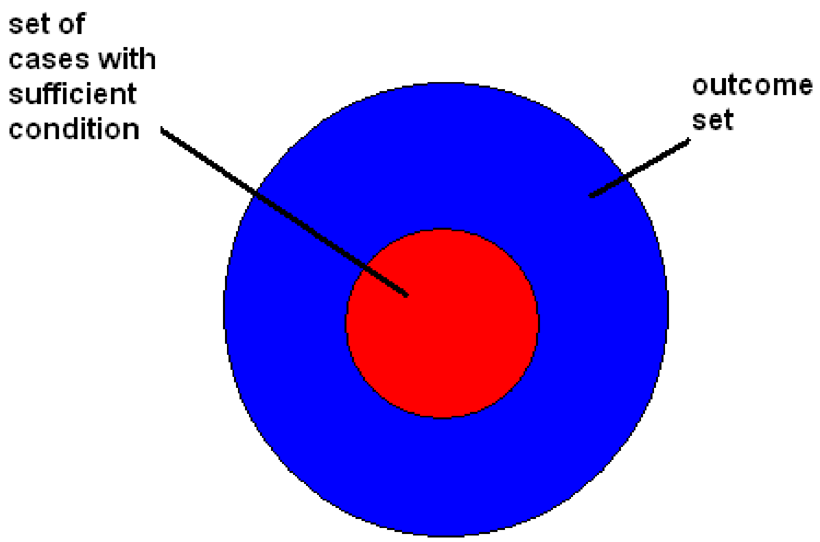
Figure 5.1 A perfect necessary condition



Sufficient conditions

Searching for a sufficient condition involves, instead, repeated application of the method of difference. In practical terms, this involves comparing pairs of configurations that only differ by one factor. So, if every instance of a factor is followed by the outcome, we can say that that factor is a sufficient condition. In set-theoretic terms, the set of cases with a sufficient condition is a subset of the set of cases with the outcome and a perfect sufficient condition is shown in Figure 5.2. Recognition of this repeated application is found in the language of QCA where we talk of necessary and sufficient *conditions* (which may comprise several causal factors) suggesting that the overall 'cause' may be a larger entity and very complex.

Figure 5.2 A perfect sufficient condition



It is important to remember that using QCA allows us to look for many paths to the solution. When analysing with regard to sufficiency, we can examine which combination of factors is sufficient for the outcome whilst recognising that another, possibly very different, combination can also be sufficient. A separate, but relevant, point to note here is that using QCA does not require that all potential causes be measured and incorporated into any model produced (Ragin, 2000).

I discuss below how to search for such conditions using real social data. When examining the social world, it is unusual to encounter such examples of perfect necessity or sufficiency and I explain below how to manage this within QCA. In this study, I am concerned with examining sufficient conditions because, as I explain later, these are integral to typology formation. I note here that there are authors[20] who contend that all

[20] For more on this area of contention, see Schneider and Wagemann, 2010.

QCA should involve (and, indeed, start with) an analysis of necessary conditions but I argue that nothing additional about sufficiency can be deduced from an analysis of necessary conditions.

As my focus is analyses of sufficiency, I now restrict any detailed comment to that area. I explain below how the consistency measure of each configuration indicates the degree to which that configuration is sufficient and how to determine sufficiency when using real social data which may have no examples of perfectly sufficient conditions.

Quasi-sufficiency

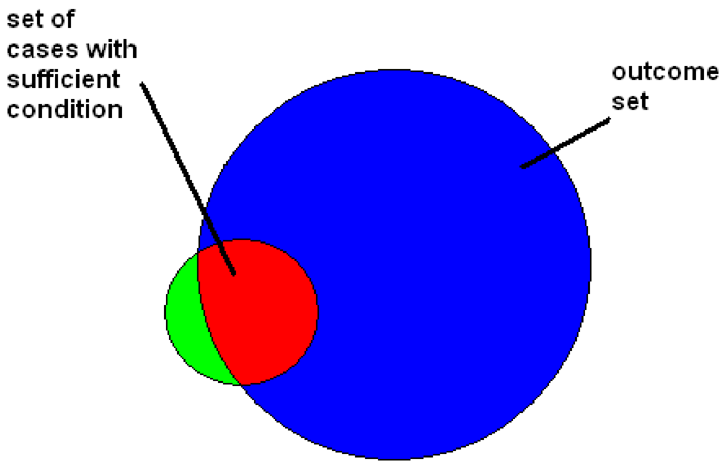
As noted above, with real social data, it is rare to find instances of perfect sufficiency. The example truth table shown earlier (Table 5.3) shows a variety of consistency values and represents a more common situation. Even in the rows with high consistency scores, if those scores are not 1, there will be some cases which do not achieve the outcome. We need, therefore, a way of deciding what level of consistency score is high enough to deem that the associated configuration should be considered sufficient. Ragin (2000) suggests that a consistency threshold be set and that rows with consistencies above this threshold be considered sufficient. I argue, along with other users of QCA on large data sets like Cooper and Glaesser (2008), that rows above the consistency threshold be termed 'quasi-sufficient' to distinguish them from rows with perfect sufficiency. In large datasets, I suggest that this distinction must be made clear because, in crisp set QCA, a row can have a high consistency whilst still having a large number of cases which do not achieve the outcome measure.[21]

Looking back at Figure 5.2, we see that all cases with a sufficient condition were contained within the outcome set (and therefore achieved the outcome). A similar diagram showing

[21] For example, a row with 1000 cases could have a consistency of 0.9 which means that 100 cases do not achieve the outcome.

a non-perfect sufficient condition, as in Figure 5.3, shows us a situation where most cases with the condition also have the outcome. The consistency measure allows us to ascertain what proportion of cases are in the red section of Figure 5.3 (and therefore do achieve the outcome) and what proportion with the condition are in the green section (and do not achieve the outcome). So, we must then decide what level of consistency indicates that a condition is quasi-sufficient as, we can see with the aid of Figure 5.3, too low a score indicates that the green section is too big in relation to the red.

Figure 5.3 A quasi-sufficient condition



Setting the consistency threshold

Since, as mentioned above, it is unlikely that we will find configurations which are perfectly sufficient in all types of real social data, we must set a consistency threshold which indicates the lowest consistency score for a row to be considered quasi-sufficient. This is a decision which is made by the researcher and represents one of the points in the research process where Ragin (2000) suggests that expert knowledge from the researcher is required.

Perhaps predictably, this is one area of process of QCA which has been criticised by researchers who claim that choosing a consistency threshold gives the researcher the ability to manipulate results (Lieberson, 2004). Others claim that the issue does not receive enough methodological discussion and that neither critics of QCA nor its supporters have put forward a clear case to support researcher-led threshold setting or to dismiss it (Skaaning, 2011). While Skaaning (2011) is correct to note that the issue is not often debated in much detail, both he and Lieberson (2004) help to perpetuate the myth that standard statistical methods do not suffer from the same problem. Lieberson (2004) is particularly critical and contends that QCA has a deterministic approach which, when coupled with the researcher's freedom to, amongst other things, set consistency thresholds, leads to misleading results.

I suggest that, far from being a weakness, one of the great strengths of QCA is that the researcher is constantly faced with decisions, such as choosing a consistency threshold, when the equivalent decisions in regression-type analyses would be obscured by sophisticated software packages or standardised procedures. The software package fs/QCA is fairly basic and requires a great deal of researcher input both during the process of analysis and when interpreting results.

This is because, as Ragin (2004) asserts repeatedly, QCA relies on the researcher's extensive 'case-oriented knowledge'. It is a process developed to lend structure and rigour to case-based analyses and so must make use of the researcher's knowledge if it is not to rest on stereotypical judgements. In essence, QCA should be used for different purposes to regression models and Rihoux and Ragin (2009) insist that it should not be seen as a direct replacement for regression-style analyses. Instead, QCA allows case-based researchers to work with larger numbers of cases than more ethnographic methods allow for and gives a logical framework for making cross-case comparisons. I should perhaps add that, notwithstanding these claims concerning case-oriented knowledge, Ragin himself has used QCA with hundreds of cases (Ragin, 2006). This is clearly an area, among QCA users, where views are not yet settled.

In any case, as Berger and Berry (1988) argue, subjective judgements cannot be avoided in standard statistical methods either. They suggest, as I do in above, that much of the subjectivity in standard statistical processes is hidden from the researcher and also standard practices rely on judgements about data which may have occurred but did not (Berger and Berry, 1988). I focus more on this second point later in the section when I discuss counterfactual reasoning in QCA. For now, I simply argue that the attacks from some commentators on the interpretation required in QCA imply that such subjectivity does not occur in other statistical methods and that it is not preferable to have any subjectivity in data analysis. For me, as for Berger and Berry (1988), 'acknowledging the role of subjectivity in the interpretation of data could open the way for more accurate and flexible statistical judgements'.

If we, then, accept that setting a consistency threshold is a reasonable thing to do when attempting to determine whether or not a configuration is quasi-sufficient, we must consider what a reasonable value for this threshold is. We have seen above how a value of 1 represents perfect sufficiency and so, conversely, a value of 0 must represent perfect insufficiency. Another way of conceptualising this is to consider a configuration with consistency of 0 as being perfectly sufficient for the negation of the outcome being studied. For example, if the outcome measure is 'passed mathematics test' then a configuration with a consistency score of 0 would be perfectly sufficient for the negated outcome, namely 'did not pass mathematics test'. The higher the consistency score, the more cases from that row have the outcome. High consistency scores should, however, be viewed in conjunction with the number of cases in the row as low numbers can sometimes produce consistency scores which are misleading[22].

Boolean minimisation

Given a well-chosen consistency threshold, the next stage in the process of QCA is to attempt to produce a simplified expression which summarises all those configurations which are quasi-sufficient. The fs/QCA software uses the Quine-McClusky algorithm to compare pairs of rows and removes the restriction on particular factors being present or absent if, given an otherwise identical configuration, the presence **or** absence of a factor leads to the outcome being achieved.

The underlying mathematical structure to QCA is Boolean algebra. I briefly discuss some of these rules here before showing how they can be applied to produce simplified expressions which summarise sufficiency for a given dataset.

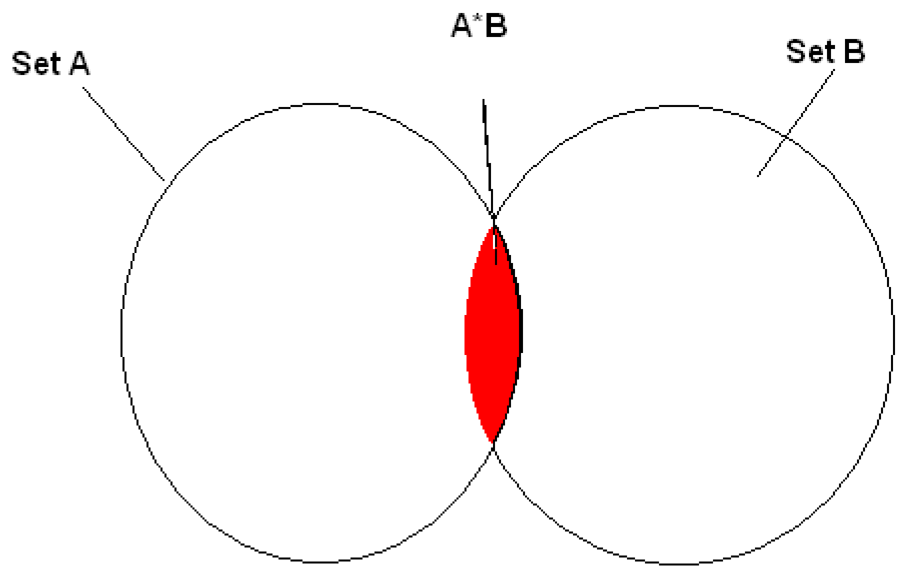
Logical AND

Logical AND (or set intersection), indicated by a '*' in QCA (and '∩' in logic), shows that a case must have membership in both sets conjoined by the *. Figure 5.4 represents this diagrammatically. For example, if we have the expression male* DEGREE, this describes all cases representing women with a degree. It corresponds to the section where two sets overlap; as seen in the diagram below where A and B overlap to form A*B. Of course, not all sets have this overlap. In QCA, unlike in regression analyses, there is no precondition that variables must be independent. If we have two (or more) such distinct sets, for

[22] Ragin (2000) draws a distinction between a 'veristic' approach to assessing sufficiency and a probabilistic one. In the veristic approach, we can call a configuration 'perfectly sufficient' if all cases (however small the number) of that configuration obtain the outcome. When low numbers of cases yield near-perfect consistencies, however, we must be willing to take into account that the cases we have happen, through sampling error, to be the ones of that type which do obtain the outcome.

example, X and Y, we can infer a relationship between the sets – namely that being a member of X is sufficient for non-membership of Y.

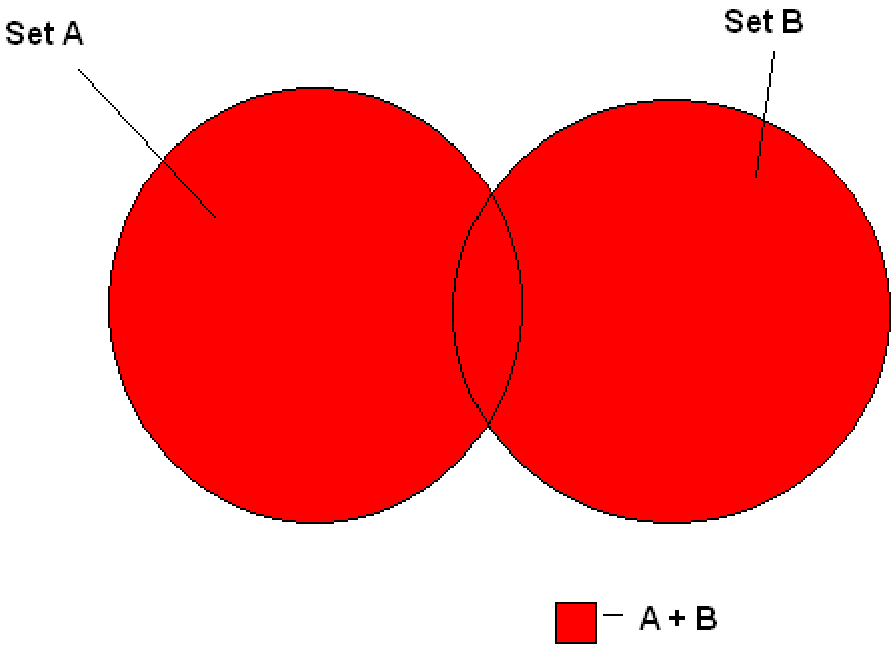
Figure 5.4 Diagram representing logical AND



Logical OR

The set operation logical OR (or set union), represented in QCA by a '+' (and in logic by '∪'), shows that a case can be in either of the sets conjoined by the +. For example, the expression 'male · DEGREE' denotes the all cases that are either female or have degrees. The overlap between these sets, women with degrees, is also included. To have membership in this expression only requires membership in one of the sets joined by the OR, as shown in Figure 5.5 In the diagram below, we can see that A∪B covers a larger area than either of the sets individually. This will always be the case unless A and B contain exactly the same cases (or one is an empty set).

Figure 5.5 Diagram representing logical OR



Set negation

Sometimes, we want to examine the configurations which lead to a particular outcome and also those configurations which lead to the outcome not being achieved. In other words, we may want to know which configurations lead to full non-membership of the outcome set. The easiest way to do this is to look at the negation of the outcome measure. This creates a new set where the membership scores are calculated from the expression 1 – (membership score in original set). For crisp sets, this simply reverses full membership and full non-membership.

Representing cases as configurations of factors

Using a combination of the above set operations and remembering the notational conventions for representing cases which are in or out of sets, we can now represent 'cases as configurations' of set memberships (Ragin, 2000). This means we can organise datasets with any number of cases into categories each representing a different combination of set memberships. For Ragin (2000), this offers a way of representing and analysing causal complexity that standard variable-based methods cannot offer.

QCA assumes that each case in the dataset has a level of membership in several sets which indicate social categories or characteristics and a level of membership in the outcome set (Ragin, 2000). In the crisp-set context, these membership levels can take on the value 0 or 1 to indicate full non-membership or full membership in the set. This corresponds to the absence or presence of a particular social category or characteristic in that case. In fuzzy-set QCA, the score of membership can take any value between 0 and 1 with the scores closest to 1 indicating the highest level of membership. The principles of Boolean algebra allow us to produce a simplified account of which configurations of set memberships lead to the outcome being achieved.

These rules of logic, when applied repeatedly, can make a complex collection of set memberships into a simple statement. I outline these rules below and explain how they work in both the crisp- and the fuzzy-set context. The fs/QCA software will apply these rules and produce an answer but it is essential to have an understanding of how the rules work in order to check for errors.

Bearing this in mind, researchers set a threshold for consistency during analysis and include the rows above the threshold into the solution. The fs/QCA software then uses Boolean algebra to produce a simplified version of this solution of the form:

$$Y = (A*B*c) + (A*C*D*E)$$

where Y is the outcome measure and A,B,C,D and E are factors (Mahoney & Goertz, 2006).

This notation allows the reader to see quickly (once familiar with the concepts) what may be happening in the dataset. The solution has 2 terms, contained in brackets, which can each be thought of as routes to the outcome (Ragin, 2006a). The notation uses upper case to show a factor is present and lower case to show it is absent. As mentioned earlier, the symbol * is used to indicate the intersection of the sets in question (often referred to as "logical AND") and the symbol + is used to indicate set union (also called "logical OR"). So, in this example, one route to the outcome is for the configuration to contain factors A, B and not factor c. Notice that this term makes no stipulations about factors D and E. Another route to the outcome is for the configuration to contain all of the factors A, C, D and E. QCA cannot tell us definitively that these are the only two possible routes to the outcome but that, given a well-chosen consistency threshold, a high proportion of cases described by either term will obtain the outcome.

<u>Determining quasi-sufficiency</u>

We want our consistency threshold to be high enough to ensure almost all of the cases in a row above the threshold obtain the outcome but it is not enough to pick a value and blindly exclude all rows below it. We must, at the same time, group together rows with negligible differences in consistency[23]. In Table 5.3, for example, we can see that rows 3,4 and 5 have negligible differences in consistency and it would be misleading to include only one or two of these rows into the solution. So, here, we should choose to set the consistency

[23] Ragin (2006) suggests a lower limit of consistency of 0.75 as it is difficult to claim a genuine subset relation if the row is less consistent than this. In my analyses, I aim to adhere to this lower limit but discuss whether, in each instance, rows which fall beneath this level can be legitimately excluded.

threshold at 0.8 and exclude all 3 or 0.72 (and include all 3). This final judgement depends on what level of sufficiency is appropriate in a particular piece of research[24].

If we think of each term in a solution as being one route to the outcome, it is helpful to know the 'empirical importance' of each of these routes (Ragin, 2006a). We do this by dividing the number of cases in a configuration which obtain the outcome by the total number of cases in the sample which obtain the outcome to produce a number called the 'coverage' of a configuration.

When interpreting a piece of fs/QCA output, we are given several (slightly different) values for coverage. For each term, we have a 'raw coverage' score which tells us the gross coverage of the term and does not take into account whether any configurations represented by the term also occur in another term. The 'unique coverage' of a term allows us to see the proportion of the outcome which is only being covered by that term.

In Table 5.4, we see all the possible configurations of the factors 'A','B','C' and 'D', their consistencies and how many cases are represented by each. If we include all the rows marked 'quasi-sufficient' in the solution, we get the output in Figure 5.6. Looking at Figure 5.6, we see that 'b*D' accounts for approximately 28% of the outcome while 'a*D' and 'C*D' account for approximately 14% and 35% respectively. All of these terms, however, have a unique coverage of under 0.01 which means that none of them, uniquely, account for more than 1% of the outcome.

To understand why the three terms have such low unique coverage, we must think of them as collections of rows from Table 5.4. The only quasi-sufficient row unique to 'b*D' is the row 'A*b*c*D' with 28 cases. Similarly, the only quasi-sufficient row unique to 'a*D' is 'a*B*c*D' with 10 cases and to 'C*D' is 'A*B*C*D' with 87 cases. We often find output like that in Figure 1 empirically, where some of the terms have a factor or

[24] A consistency of 0.8 or above, for example, can tell us that a particular configuration is 'almost always' sufficient whilst 0.7 could indicate the configuration is 'usually sufficient' (Ragin, 2000).

several factors in common. Examining the raw and unique coverage scores for each term shows us how much of the outcome in general is being explained by the term and how much is uniquely covered by it.

Table 5.4: Example truth table

A	B	C	D	number of cases	consistency	quasi-sufficient?
0	1	1	1	44	0.98	yes
1	0	1	1	184	0.95	yes
0	0	1	1	110	0.95	yes
0	0	0	1	13	0.92	yes
1	1	1	1	87	0.92	yes
0	1	0	1	10	0.9	yes
1	0	0	1	28	0.89	yes
0	0	1	0	159	0.74	no
1	0	1	0	164	0.69	no
0	1	1	0	161	0.67	no
0	0	0	0	53	0.60	no
1	0	0	0	83	0.60	no
1	1	0	1	15	0.60	no
1	1	1	0	191	0.54	no
0	1	0	0	152	0.48	no
1	1	0	0	199	0.43	no

Figure 5.6 fs/QCA output for Table 5.4 with consistency threshold = 0.80

```
                       raw        unique
                     coverage    coverage    consistency
                    ----------  ----------  -----------
b*D+                 0.278169    0.022007    0.943284
a*D+                 0.147887    0.007923    0.949153
C*D                  0.353873    0.070423    0.945882

solution coverage: 0.394366
solution consistency: 0.941176
```

From the above reasoning, it is clear that we want our consistency threshold to be nearer to 1 than 0. In fact, the point equidistant to these extremes, the value 0.5, indicates the point at which there is maximum ambiguity about the status of the configuration because it is neither sufficient nor insufficient. So, we actually want the consistency threshold to be greater than (but not equal to) 0.5.

The need for judgement occurs when deciding exactly which value between 0.5 and 1 the consistency threshold should take. Ragin (2004) suggests that the minimum consistency value that can reasonably indicate quasi-sufficiency is 0.75. In the crisp context, this means that a particular configuration has 75% of its cases achieving the outcome. I argue that it is not helpful to engage in detailed discussions about what precise values should and should not be a threshold but that researchers, instead, should make sure that the conclusions they draw about (quasi-)sufficiency are appropriate for the threshold that has been chosen.

To make this point clearer, I use the following example. Table 5.5 is a truth table showing all the possible combinations of 3 factors, A, B and C, ordered by consistency. To impose a consistency threshold on this table and classify rows as quasi-sufficient, we must first know whether the 3 factors are expected (theoretically) to contribute to the outcome or not. By this, I mean, do we expect that the presence of each factor will make the outcome more likely to occur? I suggest that for ease of interpretation, QCA models should be constructed so that this is the case, wherever possible. This does not limit us to including only those factors which, theoretically, make the outcome more likely to occur because we can configure other factors in such a way that their absence is represented in the table (when it is their absence that makes the outcome more likely to occur).

Table 5.5 Truth table for factors A, B and C

Row number	A	B	C	number	consistency
1	0	1	1	450	0.89
2	0	0	1	691	0.82
3	1	0	1	370	0.8
4	1	1	0	228	0.75
5	1	1	1	100	0.74
6	1	0	0	349	0.44
7	0	0	0	208	0.27
8	0	1	0	84	0.12

In Table 5.5, all the factors are theoretically thought to contribute to the outcome. Taking Ragin's (2004) lower limit of 0.75 as a starting point, we can start to assess what an appropriate consistency threshold for Table 5.5 would be. To adhere strictly to 0.75 as a lower limit would, however, exclude the 5th row (with a consistency of 0.74) from any simplified solution indicating quasi-sufficiency. I argue here that we must examine what comprises this 5th row as well as looking at the distribution of consistency scores across the whole of the table before deciding whether to include the row or exclude it.

In the case of Table 5.5, there is a gap of 0.3 between the 5th and the 6th rows which represents the biggest gap between concurrent rows in the table. Further, since we expect the presence of the factors here to increase the likelihood of the outcome occurring, we would expect the configuration with all 3 factors to be quasi-sufficient if other rows where only one or two of the factors are present are also quasi-sufficient. I suggest that taking these steps is in the spirit of what Berger and Berry (1988) were arguing for. In a fabricated example such as this, it is difficult to discuss the process of subjective judgements that comprise setting a consistency threshold in detail. Later, when discussing the QCA results, I justify particular consistency thresholds with specific reference to the area being studied. In this section, I merely aim to show that the process of setting such thresholds is not as simple (or inflexible) as selecting a value and blindly excluding all rows which fall below it.

In any case, the software package fs/QCA allows for any level of consistency threshold to be selected before it performs the Boolean minimisation on all the rows which lie above the threshold. This does not mean, however, that any level of consistency can be considered a threshold for quasi-sufficiency. Another layer of subjectivity exists in the interpretation of results. Just as I term rows with high consistencies (but not the consistency 1) to be quasi-sufficient, so do I argue, along with Ragin (2000) that other relevant qualitative markers be introduced which relate the degree of sufficiency to the consistency threshold in words. For example, if you wanted to know which configurations were ‘almost-always sufficient’, you would set a very high consistency threshold of, say, 0.9 or above (Ragin, 2000). A consistency threshold of 0.75 could be said to indicate which configurations were ‘usually sufficient’ (Ragin, 2000). Thus, the consistency threshold must relate to the specific aims of the research and results must be reported with reference to qualitative markers, where necessary, to make it clear to the reader what level of consistency was employed as a threshold for sufficiency testing.

Methodological Challenges in QCA

In this next section, I provide examples of some methodological challenges associated with QCA. To do this, I use examples from real social data (BCS70) and explain how to overcome such methodological challenges. The number of cases, 2687, in this sample is lower than in the sample overall because I have excluded those cases without values on the factors discussed below.

Specifically, I analyse two proposed solutions to the problem of limited diversity in social data. Firstly, however, I set out how I have derived the factors in my model from the

BCS70 data including details about calibration. In order for a dataset to be suitable for entry into the fs/QCA software, it must contain no missing cases and, for each case, all factors must take a value between 0 and 1. In the crisp-set context, as used here, all factors must take either the value 0 or 1. I explain in each case how I have translated the BCS70 data into a form suitable for QCA.

Factors in the model

Mathematics attainment

Mathematics attainment in BCS70 was measured using 'The Friendly Maths Test'. This test was administered to the 10 year-old children contained 72 questions, not in order of difficulty. The test was specifically designed so that most children would be able to obtain a score above 0 and a child's score was calculated by summing the number of correct answers. The mean score of the test in our sample was 51.39 which is higher than the mean for the whole sample, 49.35. The Friendly Maths Test (FMT) scores were used to create several crisp outcome measures. These indicate whether a child is in the top scoring 5, 25 or 50% (of the overall BCS70 cohort) for mathematics attainment. As a result, we will have, proportionally, more cases achieving the outcome than in BCS70, as a whole.

Social class

The social class categories are derived from the Registrar General's (RG) class categories in BCS70. Those 5 class categories have been reduced to 3 by grouping together those which are most qualitatively similar. Figure 5.7 shows the original RG categories, their descriptions and the new categories. Particularly of note is that Class III remains split with the non-manual part constituting its own class entirely in the new scheme. As Cooper and Glaesser (2008) note, there are problems with using the RG class scheme for sociological analysis but it was the class scheme in use when the data were collected and so we use it here[25].

Figure 5.7: Collapsed class categories (from Cooper and Glaesser, 2008)

Category labels	Summary description	Collapsed category labels
I	Professional	Professional, managerial and technical (PMT) class
II	Managerial-technical	
IIINM	Routine non manual	Intermediate class
IIIM	Skilled manual	Working class
IV	Partly skilled	
V	Unskilled	

To account for the 3 different crisp social classes, two social class factors were entered into the model giving the full range of configurations of each class factor with the other factors. One of these represented the PMT class, the other the working class. The two class factors serve as dummy variables and so, where there is a '0' in both the 'working class' column and the 'PMT class' column, the case is in the intermediate class. This method produces some rows which do not, in fact, represent any real cases as there can, logically, be a '1' in both columns. These redundant rows which have, of course, no cases are excluded from the analysis at the minimisation stage.

Maternal interest[26]

The factor describing maternal interest comes from question J097 in the 1980 sweep of the Birth Cohort Study (BCS70). It was answered by the child's teacher and so gives his or her perspective on the involvement level of the parent. The exact question was:

[25] For more on this the sociological problems with the RG scheme, see Prandy(1999).
[26] Exactly the same question was asked about paternal interest (replacing 'mother' with 'father'). I show some results for paternal interest in Chapter 6.

"With regard to the child's education, how concerned or interested does the mother appear to be:

- *Very interested*
- *Moderately interested*
- *Very little interested*
- *Uninterested*
- *Cannot say/no parent figures"*

To create the crisp measure of maternal interest, I coded 'Very interested' as 1 and 'Moderately-', 'Very little-' and 'Un- interested' as 0. 'Cannot say/no parent figures' was classed (by me) as missing data. Thus, we can qualitatively talk of a high level of maternal interest (as experienced by the child's teacher) being represented by the presence of this factor.

Sex of the child

This information comes from the first sweep of the BCS. I call my factor 'MALE' here to be consistent with other pieces of literature using QCA. Hence, a '1' in the male column represents a boy and a '0' represents a girl.

General ability

The additional factor being introduced later in the paper is an indicator of ability at age 10. This is derived from the British Ability Scale (BAS) test scores in BCS70. The mean test score for my sample was 40.75 compared with 37.58 in BCS70, as a whole. As with the FMT scores, I have created several crisp outcome measures by considering the top 5, 25 and 50% of general ability in the BCS70 cohort with more children, proportionally, achieving these outcome levels than in BCS70.

Limited Diversity

One additional problem of spreading the same number of cases over double the number of rows is an increased likelihood of having rows with very low numbers of cases in them.

For Ragin (2004) who usually deals with smaller sample sizes, a remainder row is taken to mean a row with no cases at all. I suggest that, for large-n QCA, remainder rows may not be completely empty but, instead, contain relatively few cases. For the purposes of the analyses here (and in Chapter 6), I have considered remainder rows to be rows with fewer than 20 cases (unless otherwise stated)[27]. Considering that the consistency measure is sensitive to case numbers, I could also find these rows exhibiting extremely high consistencies and, hence, being candidates for inclusion into the solution. What I face, here, is the problem of limited diversity in the data. Ragin (2006b) argues that limited diversity is a common rather than an exceptional problem when investigating the social world and one which often complicates analysis of social data.

Two different approaches to dealing with limited diversity in QCA have been represented thus far in the methodological literature, namely the ‘two-step method’ advocated by Schneider and Wagemann (2006) and the use of counterfactual reasoning as proposed by Ragin (2004). In Thomson (in press), I discuss how these approaches differ and evaluate them using real and invented data. I summarise those points here to show how counterfactual reasoning is preferable for the research I carry out.

Counterfactual reasoning and the counterfactual method

When ordering a truth table by consistency, I want to be able to justify the inclusion of any rows above our consistency threshold in a simplified solution. If some such rows have few cases, this becomes difficult to justify using the data alone. Rows with low numbers of cases are called remainder rows and can be incorporated into a simplified solution provided care is taken. In the counterfactual method, the researcher must not only consult theory to ascertain what the *expected* outcome of such a remainder row is (i.e., whether it

[27] For more on choosing a threshold for remainder rows, see Mendel and Ragin (2011).

achieves the outcome) but also assess the impact of that row's inclusion on the simplified solution.

Ragin (2006b) notes that we could choose to exclude all remainder rows to produce the most complex solution but that this might turn out to be too complicated to make sense of the data. Similarly, he suggests that we could include all remainder rows (with no theoretical evaluation of their likely outcome) to produce the most parsimonious solution (Ragin, 2006b). These two solutions produce upper and lower bounds for the complexity of the solution. Between these boundaries lies a potential solution including only those remainder rows which, after theoretical inspection, we think ought to be there. This 'intermediate solution' sits, on a continuum of complexity, between the most complex and the parsimonious solutions (Ragin, 2006b)[28].

Types of counterfactual reasoning

The type of counterfactual reasoning employed in a piece of QCA depends on the configuration of factors in the remainder row under study and the configuration of factors in other rows included in the simplified solution. Ragin (2006b) terms a remainder row under consideration for inclusion into the solution as a 'counterfactual' and so, to be consistent, I will do the same. Broadly speaking, there are two types of counterfactuals – 'easy' and 'difficult' (Ragin, 2006b).

Consider the factors A, B and C that are all thought to contribute to an outcome, X[29]. Given an outcome, X, a solution, A*B*c which leads to X, and some theoretical knowledge about factors A, B and C, the researcher might think it is the presence of the conjunction 'A' **and** 'B' alone that is producing the outcome and that 'c' is superfluous. The researcher would want, then, to remove 'c' to simplify the solution and to give a

[28] It could be, however, that we decide, after theoretical inspection, either to include or to exclude all remainder rows above the consistency threshold and so the final solution may match either the parsimonious or most complex solution.
[29] If we include factors whose absence is thought to contribute to X, the reasoning that follows would be reversed for those factors.

clearer summary of what is happening. To do this, the row A*B*C would also need to obtain the outcome X. In this example, however, A*B*C has very few cases and is a remainder. Since the presence of C is expected to contribute to the outcome and because A*B*c leads to the outcome, it follows that A*B*C should, theoretically, also obtain the outcome. It is possible, therefore, to include it in the solution and simplify to produce A*B. A remainder row like A*B*C which helps to remove the *absence* of a factor from the solution, is known as an 'easy counterfactual' (Ragin, 2006b).

Suppose, instead, that, given our solution A*B*c, we have the remainder row A*b*c. Assuming this row obtains the outcome would give the simplified solution A*c by removing 'B'. The row A*b*c is acting as a 'difficult counterfactual' here because its inclusion into the solution amounts to removing the *presence* of a factor (Ragin, 2006b). This needs greater theoretical justification because we might expect that 'B' is contributing to the outcome (based on the reasoning above). Difficult counterfactuals can be incorporated into solutions but only with care.

In the following example for an analysis drawing on my BCS70 data, I use different terms, talking of 'absent' and 'present' factors rather than 'easy' and 'difficult' counterfactuals in an attempt to be clearer about the status of a factor in the solution. Using a model with the factors sex, social-class, maternal interest, and above-average ability (top 50%) and an outcome of the top 50% of mathematics attainment, I attempt to construct intermediate solutions. First, I will consider whether any absent factors can be removed from any of the terms before checking the parsimonious solution to see if any further simplifications can be justified[30].

[30] We do not assume here that removal of absent factors necessarily requires an easy counterfactual rather than a difficult one because the *presence* of some of our factors, such as PMT CLASS and MALE, is not certain to contribute to above-average attainment in mathematics.

Example of the counterfactual method

In Table 5.6, the consistency threshold is set at 0.75, which means only the top 5 rows are quasi-sufficient. Of these, only one is a remainder (highlighted), as defined earlier, although there are several other remainder rows further down the table that might need to be considered.

Creation of the intermediate solution

In Figure 5.8, the most complex solution is obtained by excluding all remainders. Note the significant overlap between the three terms of the solution as demonstrated by their low unique coverage scores. This solution shows a restrictive outcome for girls – they must be in the PMT-class, in the top 50% of general ability, *and* have an interested mother to achieve the outcome. Boys in either the intermediate-class also must be in the top 50% of general ability and have an interested mother to achieve the outcome. PMT-class boys need only to be in the top 50% of ability; they can achieve the outcome even without an interested mother. For working-class children and intermediate-class girls, there is no quasi-sufficient route to the outcome.

Table 5.6: Truth Table for maternal interest and the top 50% of ability with outcome 'top 50% of mathematics attainment'

row number	male	working-class	PMT-class	maternal interest	ability (50%)	number	consistency	quasi-sufficient?
1	1	0	0	1	1	79	0.94	yes
2	1	0	0	0	1	17	0.88	yes
3	1	0	1	1	1	278	0.88	yes
4	0	0	1	1	1	228	0.79	yes
5	1	0	1	0	1	72	0.75	yes
6	1	1	0	1	1	187	0.71	no
7	0	0	0	1	1	53	0.7	no
8	0	1	0	1	1	154	0.66	no
9	0	0	0	0	1	13	0.54	no
10	0	0	1	0	1	44	0.52	no
11	1	0	1	1	0	66	0.48	no
12	1	1	0	0	1	97	0.47	no
13	1	0	0	1	0	17	0.47	no
14	0	1	0	0	1	85	0.33	no
15	0	0	0	1	0	19	0.32	no
16	0	0	1	1	0	42	0.29	no
17	1	1	0	1	0	98	0.28	no
18	1	0	1	0	0	34	0.23	no
19	0	0	1	0	0	18	0.17	no
20	1	1	0	0	0	125	0.11	no
21	0	1	0	1	0	56	0.11	no
22	0	1	0	0	0	88	0.09	no
23	1	0	0	0	0	14	0.07	no
24	0	0	0	0	0	6	0	no

Figure 5.8 Most complex solution for Table 5.6 with consistency threshold = 0.75

```
                                                  raw        unique
                                               coverage     coverage    consistency
                                               --------     --------    -----------
MALE*PMTCLASS*ABILITY(50%)+                    0.278765     0.050515     0.851429
MALE*workingclass*MATERNAL INTEREST*ABILITY(50%)+ 0.297474  0.069224     0.890756
PMTCLASS*MATERNAL INTEREST*ABILITY(50%)        0.397568     0.169317     0.839921
solution coverage: 0.517306
```

```
solution consistency: 0.841705
```

In the parsimonious solution in Figure 5.9, notice that the term, 'PMTCLASS*MATERNAL INTEREST*ABILITY(50%)' from Figure 5.8 reappears and, hence, is as simplified as possible (whilst still adhering to a consistency threshold of 0.75). The route to the outcome for PMT-class girls, therefore, is unchanged. There is still no route to the outcome for working-class children and intermediate-class girls. Now, intermediate-class boys *and* PMT-class boys only need to be in the top 50% of general ability to achieve the outcome.

Figure 5.9 Parsimonious solution for Table 5.6 with consistency threshold = 0.75

```
                                          raw        unique
                                        coverage    coverage   consistency
                                         ------      ------       ------
MALE*workingclass*ABILITY(50%) +         0.362021    0.133770    0.867713
PMTCLASS*MATERNAL INTEREST*ABILITY(50%)  0.397568    0.169317    0.839921
solution coverage: 0.531338
solution consistency: 0.842730
```

The goal is to simplify 'MALE*workingclass*MATERNAL INTEREST*ABILITY(50%)' from Figure 5.8 to 'MALE*workingclass*ABILITY(50%)' from Figure 5.9. Then, the term 'MALE*PMTCLASS*ABILITY(50%)' from Figure 5.8 can be absorbed into 'MALE*workingclass*ABILITY(50%)' and so it will not appear separately in the solution. Theoretically, though, it might be expected that maternal interest is contributing to the outcome and because the only evidence against this expectation is the (highlighted) remainder row in Table 5.6, this simplification is unjustifiable.[31]

In this case, then, the intermediate solution, in Figure 5.10, is the same as the most complex version. If our parsimonious solution, in Figure 5.6, had relied on the inclusion of more remainder rows, a solution would result that is positioned between the parsimonious and most-complex versions, in terms of complexity.

Figure 5.10 Intermediate solution for Table 5.6 with consistency threshold = 0.75

	raw coverage	unique coverage	consistency
	-----	-----	-----
MALE*PMTCLASS*ABILITY(50%)+	0.278765	0.050515	0.851429
MALE*workingclass*MATERNAL INTEREST*ABILITY(50%)+	0.297474	0.069224	0.890756
PMTCLASS*MATERNAL INTEREST*ABILITY(50%)	0.397568	0.169317	0.839921

solution coverage: 0.517306

solution consistency: 0.841705

The two-stage method

Although, as mentioned earlier, Ragin (2006b) suggests that limited diversity is something to be aware of generally in social science research, it is exacerbated by small- and medium-*n* sample sizes. In QCA, the number of possible configurations in a truth table increases exponentially with the number of factors in the model. Because each additional factor produces a set of configurations for its presence and for its absence, the number of configurations is 2^k, where *k* is the number of factors. So, for example, with 10 factors, the minimum sample size to ensure each configuration had at least one case in it would be

[31] I note here that if the ability factor was more difficult to obtain (for e.g., it was showing the top 5% of ability), then we might be able to remove the maternal interest factor.

1024. This assumes, of course, that no configuration has more than one case. In practice, however, a researcher would want more than just one case per configuration. For the same example, the minimum number of cases required to allow each configuration to have 10 cases is 10240, firmly in the realms of a large-n sample. If it is assumed that *n* is fixed (i.e., the dataset has a fixed number of cases and more cannot be added), then the only way to reduce the number of possible combinations is to use fewer factors.

Schneider and Wagemann (2006) suggest an alternative to using a simplified model with fewer factors by proposing a partitioned analysis, each with fewer factors, which, they argue, removes theoretically impossible combinations from the analysis process. Their method, originally developed in political science, has been advocated by Mannewitz (2011) as potentially relevant in other fields. In their method, the decision on how to partition factors is based on a theoretical assumption that each factor can be classed as either 'remote' or 'proximate'. A remote factor, is deemed by Schneider and Wagemann (2006) as structural and originates before the period being studied. Proximate factors are those that are more susceptible to the actors' agency.

Mannewitz (2011) argues that this distinction is not specific to factors you might see in political science but represents a distinction between 'deep' and 'shallow' factors. According to Mannewitz (2011), the important distinction to make (and one which he argues can and should be made in every QCA study) is between factors temporally distant from the outcome and those closer to it. The remote (or deep) factors are those most distant from the outcome and they are considered together in the first stage of analysis where a *parsimonious* solution is created. Crucially, any remote factors that do not appear in that parsimonious solution are dropped before the next analytic stage. After analysis of remote factors, each term in the parsimonious solution is modelled in conjunction with the proximate factors. By partitioning the analysis in this way, Schneider and Wagemann (2006) firstly create a parsimonious solution then, secondly, introduce more complexity to, they claim, 'further [specify] … the causal argument'. This simplification early in the analysis, I argue later, can lead to removing complexity that cannot be recovered in the final solution.

There are some other methodological points also to consider. First, the decision to split factors into types by temporal location is, ultimately, a subjective decision by the researcher and assumes both that this can be undertaken satisfactorily and that all the factors being considered are stable over time. There is also the added assumption that the factors are similarly located in time for all cases. To deem a factor remote assumes that it will be remote for all cases. Although this is not an extreme example of, what Ragin (2006a) terms, 'net-effects thinking' in regression models, it assumes a uniformity that might not be present.

In my work, attempting to specify the factor 'social-class' as remote or proximate would be difficult. It might be more sensitive to the agency of some actors than others. I do not claim that it is always impossible to split factors into remote and proximate and, in the case of Schneider and Wagemann's (2006) 'conditions of democracy' it might be possible to employ a meaningful distinction between them but this is not necessarily true of all social data, as Mannewitz (2011) suggests. With the kind of data being used in my example, splitting into remote and proximate factors runs counter to theory about class position and the variable capacity of different social classes to alter it[32].

In addition, distinguishing a factor as remote, rather than proximate, can mean that it is excluded from the second analytic stage altogether based on a highly subjective judgement. Thus, solutions are produced at Stage 1 which, in excluding a factor, rules out the possibility of this factor acting in a conjunctural way with any other factor at the next stage. I show below that this can happen even with crisp sets and a small number of factors. I have chosen the following example to make it easier to follow the underlying

[32] For more on this see the extensive literature on social mobility (e.g. Goldthorpe, 1987).

logical problem but note that it is possible for the problems below to occur in a model with more factors and using fuzzy sets.

Two-Stage method example (with invented data)

For example, assume, in some imaginary dataset (set out in full in Table 5.8) that there are four factors, A, B, C and D, in the model and I designate two of them as remote (A and B) and two as proximate (C and D). In carrying out the first stage of the two-stage method, I produce the following truth table.

Table 5.7 Truth table for remote conditions

A	B	number	consistency	Quasi-sufficient?
1	0	64	1	yes
1	1	64	0.78	yes
0	1	64	0.5	no
0	0	64	0	no

Here, there are no remainder rows, but, if there were and they contributed to parsimony, they would be included to create the parsimonious solution for the remote conditions. As it is, I did find a solution for this table relatively easily by observation (Figure 5.11). Notice that B is not in any terms of the solution (using a consistency threshold of 0.78). A*B and A*b collapses to A, as shown in Figure 5.11.

Figure 5.11 Solution for remote factors

	raw coverage	unique coverage	consistency
A	0.780822	0.780822	0.890625

solution coverage: 0.780822

solution consistency: 0.890625

By the rules of the two-step method, B is then dropped. I proceed to model A with the proximate factors C and D and produce the solution in Figure 5.12. This is the final solution because I found no other remote factors. So, one route to the outcome is A*d and another is A*C. The factor B cannot appear in the solution because it was dropped earlier.

Figure 5.12: Solution including proximate factors

	raw coverage	unique coverage	consistency
A*d+	0.438356	0.219178	1.000000
A*C	0.438356	0.219178	1.000000

solution coverage: 0.657534

solution consistency: 1.000000

If, instead, I proceed as normal, modelling all factors together, I get the truth table in Table 5.8 and the solution in Figure 5.12. Here, B does appear in the solution, in two separate terms. Removing it from an earlier stage of the analysis in the two-stage method produces distorted results; namely, in Figure 5.11, we see that A*C is showing as a sufficient path but, in Figure 5.12, it does not appear. The results from Figure 5.12 tell us that A*C alone is not a sufficient path and that other factors, namely B, are important in explaining the outcome[33].

I have outlined the problems that can occur with the two-stage method by examining a simple, abstract example, with four factors. I now use my BCS70 data, following the two-stage process to determine whether there are any differences between the solution it produces and the solution I found earlier. If I suppose, for this exercise, that the factors I use could, theoretically, be split into remote and proximate, it can be seen again, as above, that the initial parsimonious solution simplifies the data to the extent that the underlying complexity cannot be recovered in the final solution.

Table 5.8: Truth table with all factors included

A	B	C	D	number	quasi-sufficient?	consistency
1	1	1	1	16	yes	1
1	1	1	0	16	yes	1
1	1	0	0	16	yes	1
1	0	1	1	16	yes	1
1	0	1	0	16	yes	1
1	0	0	1	16	yes	1
0	1	1	0	16	yes	1
0	1	1	1	16	yes	1
1	0	0	0	16	yes	1
1	1	0	1	16	no	0.125
0	1	0	0	16	no	0
0	1	0	1	16	no	0
0	0	1	0	16	no	0
0	0	1	1	16	no	0
0	0	0	1	16	no	0
0	0	0	0	16	no	0

[33] This example rests on the assumption that all the factors are considered to be causally relevant in some way.

Figure 5.13: Solution obtained by including all factors together

```
           raw        unique
         coverage    coverage   consistency
         ----------  ----------  -----------
A*d+      0.438356    0.109589    1.000000
A*b+      0.438356    0.219178    1.000000
B*C       0.438356    0.328767    1.000000
solution coverage: 0.986301 solution consistency: 1.000000
```

Two-stage method example (with real data)

Assuming that our factors could be divided into remote and proximate ones and using the partitioning method, suppose that sex, maternal interest, and ability are remote. Ability could be considered a remote factor if we contend, as some authors representing the field of education do, that it is distinct from achievement and more biologically determined[34]. This leaves social class as the only proximate factor but it will, as before, be entered into the model as two dummy variables and so, could be seen as two factors jointly representing three different classes.

First, using just the remote factors, I obtained the remote solution shown in Figure 5.13. This presents us with a similar situation to Schneider and Wagemann (2006) because not all of our remote factors are included in this solution. Because 'sex' does not appear here, I discard it, in line with their rules.

[34] A great deal of the literature surrounding intelligence takes this view. For an example, see Duncan (2005). There is no space here to consider the finer points of the 'achievement versus ability' argument. The example above is constructed in this way merely to illustrate a methodological point.

Figure 5.14 Solution for remote factors

	raw coverage	unique coverage	consistency
	----------	----------	-----------
MATERNAL INTEREST*ABILITY(50%)	0.721235	0.721235	0.787538

solution coverage: 0.721235

solution consistency: 0.787538

Second, I combine the proximate factors with the remote factors that appear in the solution in Figure 5.13 to create the final version of the solution in Figure 5.14.

Figure 5.15 Final version of the solution (including some remote and all proximate factors)

	raw coverage	unique coverage	consistency
	-----	-----	-----
ABILITY(50%)*MATERNAL INTEREST*workingclass	0.501403	0.501403	0.840125

solution coverage: 0.501403

solution consistency: 0.840125

So, ABILITY (50%)*MATERNALINTEREST*workingclass is quasi-sufficient in Figure 5.14, which is a substantially different solution from the one in Figure 5.10 where all the factors interacted. In Figure 5.10, there are different routes to the outcome for boys and girls but the factor 'sex' is completely excluded from the two-stage solution in Figure 5.14. It is this kind of complexity that can be lost when employing a two-stage analysis because the parsimonious solution is created first and then more complexity is added. On the other hand, in using counterfactual reasoning, I use the most complex version of the solution and the parsimonious one as boundaries within which the solution must fall. Proceeding in this way means that complexity is not hidden at an early analytic stage.

Summary

In this chapter, I have outlined how QCA can be used to create typologies and suggested that configurations, or rows in a truth table, each represent a different type. I explained how, when the dataset is properly calibrated, using QCA allows us to search for conditions (or configurations) that are necessary or sufficient (or both) for a given outcome.

I then provided a description of the factors I analyse so that I could use real BCS70 data to explore the problems of limited diversity in social data. I discussed two proposed solutions to this and showed that the counterfactual method is preferable because, as it removes complexity at the end of the analytic process, it does not mechanically produce distorted results. Rather, the counterfactual method forces the researcher to examine, in detail, any rows being included or excluded from simplified solutions because of low case numbers and provide theoretical justification for this.

In the following chapter, I present some QCA results but, noting the above discussion, choose to use the counterfactual method as an analytic tool to combat limited diversity in the dataset. I also show that limited diversity can occur in large-n samples and is not a problem restricted to small- and medium-n datasets.

Chapter 6 – QCA Results

In this chapter, I present some results of the QCA performed on the BCS70 dataset, some of which I have reported elsewhere (see Thomson, 2011). In the previous chapter, I listed the factors entered into my model and showed how they were derived. I detail below the analytic steps I took to investigate which factors, previously mentioned, were sufficient for various levels of attainment in mathematics.

I start by creating a model without the factor 'general ability' and I show the results for this initial analysis for various levels of attainment in mathematics. I offer brief descriptions in this section of what the results show but the main purpose is to show the process of QCA and how a researcher might investigate both the outcome and its negation to find quasi-sufficient solutions. I also look at maternal and paternal involvement separately in this section to ascertain if there are any differences in the results for each[35].

I then choose to focus on one level of attainment, representing those children in the top 50% of the cohort for mathematics attainment, and introduce the factor of 'general ability' into the model to refine it. I also focus on maternal interest only In this sub-section, I investigate several levels of general ability and so, for the revised model, I report the results for maternal interest only. This is because the results for paternal interest are very similar and because it makes it easier for the reader to make comparisons between these QCA results and the interview data in Chapters 7 & 8, where the focus is on maternal interest[36]. Introducing an additional factor into the model leads to limited diversity in the dataset and, as discussed in Chapter 5, I choose to use counterfactual reasoning to perform an analysis which includes rows with very low numbers of cases.

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[35] In this section, I exclude all cases with missing data on the factors 'maternal interest', 'paternal interest', 'sex of the child', 'social class' and 'mathematics attainment'. The number of cases in this section is 1977.

[36] As I explain in Chapter 7, the interview sample is primarily women. There are two fathers in the sample but they were interviewed with their children's mother.

Both these sets of analyses focus on data from the 1980 sweep of the BCS70 when the participants (Generation 1) were aged 10. The factors in that model are those outlined in Chapter 5. The next section of analysis focuses on the respondents' children (Generation 2) and uses data from the 2004 sweep of the BCS70. The factors for this analysis are slightly different but derive from comparable questions in the 2004 sweep. I compare these results for Generation 2 to those for Generation 1to see if there are any notable differences (whilst taking into account the slight differences in the model and the changes this could produce).

Finally, I perform some QCA on the interview data as a precursor to the detailed analysis presented in Chapters 7 and 8. I do this to compare what is quasi-sufficient for mathematics attainment in my sample and in the general BCS70 sample and to consider how best to conduct QCA on a very small sample.

Initial analysis

The first stage of analysis used the different levels of mathematics attainment and their negations as the outcome measure and the factors 'male', workingclass', 'pmtclass' and 'maternal interest' as factors. The next stage was a repeat of this process but with the factor 'paternal interest' instead of the maternal interest factor. In the analyses of maternal interest, cases have been filtered out if there have missing data for maternal interest even if there is data for paternal interest. The reverse of this is true for the paternal interest analysis. Some comment is provided for each table and piece of output here and an extended analysis is given for the top 50% of mathematics attainment because, as we shall see, it is the only level for which there were several quasi-sufficient configurations. All the truth tables in this section have been ordered by consistency and spare rows generated from the dummy class variables deleted. Unless otherwise stated, I use a consistency threshold of 0.75 for sufficiency (as this is the lowest level at which a row can, qualitatively, be considered quasi-sufficient according to Ragin (2004)). To consider which configurations are quasi-sufficient for each level of mathematics attainment, I create a truth table with attainment in mathematics as an outcome measure and order it by consistency. The column labelled 'quasi-sufficient?' is not generated by the fs/QCA software but is used to show which rows I consider quasi-sufficient for the outcome and, hence, which rows will be a part of any solution generated[37].

Top 5% of mathematics attainment

Table 6.1: Truth table for maternal interest with the outcome measure 'top 5% of mathematics attainment'

male	working class	PMTclass	maternal interest	number	consistency	quasi-sufficient?
1	0	1	1	390	0.14	no
0	0	1	1	328	0.09	no
1	0	0	1	110	0.06	no
1	1	0	1	403	0.04	no
1	0	1	0	143	0.04	no
0	0	0	1	86	0.02	no
0	0	1	0	89	0.02	no
0	1	0	1	329	0.02	no
1	1	0	0	390	0.02	no
0	1	0	0	320	0	no
1	0	0	0	56	0	no
0	0	0	0	43	0	no

The outcome is very hard to achieve in this situation (deliberately so) and so it is unsurprising that no rows in Table 6.1 are quasi-sufficient. In Table 6.2, all the rows are

37 In the truth table generated by the fs/QCA software, there is a column (headed by the name of the outcome measure) in which the researcher inputs 1's and 0's to indicate which rows are in the solution.

quasi-sufficient which is tells us as little about the data as having no quasi-sufficient rows. Since, for the negated outcome, the consistency values in the table are calculated from the formula [1-(consistency in the original outcome)] then Table 6.2 is an inverted version of Table 6.1. In this instance, looking at the negation has not helped us but, as we shall see, with some of the other levels of mathematics attainment, it can help us to examine the quasi-sufficient routes to being excluded from the outcome.

Table 6.2 – Truth table for maternal interest with the outcome measure 'bottom 95% of mathematics attainment'

male	working class	PMTclass	maternal interest	number	consistency	quasi-sufficient?
0	1	0	0	320	1	no
0	0	0	0	43	1	no
1	0	0	0	56	1	no
1	1	0	0	390	0.98	no
0	1	0	1	329	0.98	no
0	0	1	0	89	0.98	no
0	0	0	1	86	0.98	no
1	0	1	0	143	0.96	no
1	1	0	1	403	0.96	no
1	0	0	1	110	0.94	no
0	0	1	1	328	0.91	no
1	0	1	1	390	0.86	no

The results for paternal interest at the top-5% level of mathematics are almost identical telling us that, at least for this level of mathematics attainment, which parent is involved does not seem to make much difference for mathematics attainment. Again, no rows in Table 6.3 are quasi-sufficient and all the rows in Table 6.4 are.

Table 6.3 Truth table for paternal interest with the outcome measure 'top 5 % mathematics attainment'

male	working class	PMTclass	paternal interest	number	consistency	quasi-sufficient?
1	0	1	1	332	0.16	no
0	0	1	1	259	0.09	no
1	0	0	1	94	0.06	no
1	1	0	1	266	0.05	no
0	0	1	0	82	0.04	no
0	1	0	1	204	0.02	no
1	0	0	0	42	0.02	no
1	0	1	0	127	0.02	no
0	0	0	1	68	0.01	no
1	1	0	0	275	0.01	no
0	1	0	0	201	0	no
0	0	0	0	27	0	no

Table 6.4 Truth table for paternal interest with the outcome measure 'bottom 95% of mathematics attainment'

male	working class	PMT class	paternal interest	number	consistency	quasi-sufficient?
0	0	0	0	27	1	yes
0	1	0	0	201	1	yes
1	1	0	0	275	0.99	yes
0	0	0	1	68	0.99	yes
1	0	1	0	127	0.98	yes
1	0	0	0	42	0.98	yes
0	1	0	1	204	0.98	yes
0	0	1	0	82	0.96	yes
1	1	0	1	266	0.95	yes
1	0	0	1	94	0.94	yes
0	0	1	1	259	0.91	yes
1	0	1	1	332	0.84	yes

Top 25% Mathematics Attainment

I now consider configurations for the top 25% of mathematics achievement to see if there is more variation in consistencies and if some (but not all) rows will be quasi-sufficient. Once again, in Table 6.5, we see that no rows are quasi-sufficient but there is a greater range of consistency values which suggests that looking at the truth table for the negation (characterising the bottom 75% of mathematics attainment) may be helpful. In Table 6.6, we see that some rows are quasi-sufficient now and I can minimise these to get a simplified solution.

Table 6.5 Truth table for maternal interest with the outcome measure 'top 25% of mathematics attainment'

male	working class	PMTclass	maternal interest	number	consistency	quasi-sufficient?
1	0	1	1	390	0.52	no
1	0	0	1	110	0.46	no
0	0	1	1	328	0.40	no
1	1	0	1	403	0.28	no
1	0	1	0	143	0.27	no
0	0	0	1	86	0.24	no
0	1	0	1	329	0.19	no
0	0	0	0	43	0.16	no
0	0	1	0	89	0.16	no
1	0	0	0	56	0.14	no
1	1	0	0	390	0.10	no
0	1	0	0	320	0.05	no

Table 6.6 Truth table for maternal interest with the outcome measure 'bottom 75% of mathematics attainment'

male	working class	PMT class	maternal interest	number	consistency	quasi-sufficient?
0	1	0	0	320	0.95	yes
1	1	0	0	390	0.90	yes
1	0	0	0	56	0.86	yes
0	0	1	0	89	0.84	yes
0	0	0	0	43	0.84	yes
0	1	0	1	329	0.81	yes
0	0	0	1	86	0.76	no
1	0	1	0	143	0.73	no
1	1	0	1	403	0.72	no
0	0	1	1	328	0.60	no
1	0	0	1	110	0.54	no
1	0	1	1	390	0.48	no

Since there are several quasi-sufficient rows in Table 6.6, I can produce a simplified solution through Boolean minimisation with a consistency threshold of 0.80 (see Chapter 5 for the extended reasoning behind the setting of consistency thresholds). The solution, shown in Figure 6.1, shows there are 3 routes to the outcome. Only one of these routes included boys – pmtclass*maternal interest – which describes children outside the PMT-class without highly interested mothers.

As should be clear from the paragraph above, it can be difficult to understand what the simplified solutions to a table with a negated outcome mean, in real terms. Though I have been able to analyse Table 6.6 and produce solutions, these do not allow me to say, with more certainty, what configurations are quasi-sufficient for the outcome of top 25% mathematics attainment.

Figure 6.1 fs/QCA output for Table 6.6 with consistency threshold = 0.80

```
                                         raw         unique
                                       coverage     coverage    consistency
                                      ----------   ----------   -----------
pmtclass*maternalinterest+             0.371285     0.200504     0.911001
male*workingclass*maternalinterest+    0.055919     0.037783     0.840909
male*WORKINGCLASS                      0.287154     0.134509     0.878274
solution coverage: 0.543577
solution consistency: 0.879381
```

The data for paternal interest is, again, similar. There are no quasi-sufficient rows in Table 6.7 and Table 6.8 has several which, when simplified, produce the solution in Figure 6.2. In Table 6.8, I note that the 7^{th} and 8^{th} rows (with consistencies 0.75 and 0.748031 respectively) should both be included in the solution because of their neglible differences in consistency. For a more detailed explanation of why, see Chapter 5.

Table 6.7 Truth table for paternal interest with the outcome measure 'top 25% of mathematics attainment'

male	working class	PMTclass	paternal interest	number	consistency	quasi-sufficient?
1	0	1	1	332	0.55	no
0	0	1	1	259	0.43	no
1	0	0	1	94	0.43	no
1	1	0	1	266	0.29	no
1	0	1	0	127	0.25	no
0	0	0	1	68	0.25	no
1	0	0	0	42	0.24	no
0	1	0	1	204	0.22	no
0	0	1	0	82	0.20	no
0	0	0	0	27	0.15	no
1	1	0	0	275	0.11	no
0	1	0	0	201	0.07	no

Table 6.8 Truth table for paternal interest with the outcome measure 'bottom 75% of mathematics attainment'

male	working class	PMT class	paternal interest	number	consistency	quasi-sufficient?
0	1	0	0	201	0.93	yes
1	1	0	0	275	0.89	yes
0	0	0	0	27	0.85	yes
0	0	1	0	82	0.80	yes
0	1	0	1	204	0.78	yes
1	0	0	0	42	0.76	yes
0	0	0	1	68	0.75	yes
1	0	1	0	127	0.75	yes
1	1	0	1	266	0.71	no
1	0	0	1	94	0.57	no
0	0	1	1	259	0.57	no
1	0	1	1	332	0.45	no

Figure 6.2 fs/QCA output for Table 6.8 with consistency threshold = 0.75

```
                                  raw        unique
                                coverage    coverage    consistency
                               ----------  ----------  ----------
pmtclass*paternal interest      0.347391    0.174410    0.891743
workingclass*paternal interest  0.154396    0.115082    0.776978
male*pmtclass                   0.300929    0.150822    0.842000
solution coverage: 0.613295
solution consistency: 0.836257
```

Being a girl, not in the PMT-class, without a highly interested father is quasi-sufficient for being in the bottom 75% of mathematics which is the same result, for these children, as with maternal interest.

Top 50% Mathematics attainment

I now examine the truth tables for the top 50% of mathematics attainment. I hope that these tables will contain some quasi-sufficient rows but that not all the rows will be quasi-sufficient. In the case of maternal interest, we see in Table 9 that the top two rows are the only quasi-sufficient rows and so it is easier to see, by eye, what the simplified solution will be. It is presented in Figure 6.3 below. From Figure 6.3, we see that only boys with interested mothers who are not in the working-class have a quasi-sufficient route to the outcome.

Table 6.9: Truth Table for maternal interest with outcome measure 'top 50% of mathematics achievement'

male	working class	PMT class	maternal interest	number	consistency	quasi-sufficient?
1	0	0	1	96	0.85	yes
1	0	1	1	344	0.8	yes
0	0	1	1	270	0.71	no
0	0	0	1	72	0.6	no
1	0	1	0	106	0.58	no
1	1	0	1	285	0.56	no
1	0	0	0	31	0.52	no
0	1	0	1	210	0.51	no
0	1	1	0	62	0.42	no
0	1	0	0	19	0.37	no
1	0	0	0	222	0.27	no
0	0	0	0	173	0.21	no

Figure 6.3: fs/QCA output for Table 6.9 with consistency threshold = 0.75

```
                                      raw        unique
                                    coverage    coverage    consistency
                                   ----------  ----------  -----------
MALE*workingclass*MATERNAL INTEREST 0.334892    0.334892    0.813636
solution coverage: 0.334892
solution consistency: 0.813636
```

I can, then, examine the table (Table 6.9) for the negated outcome (i.e. look at the bottom 50% of mathematics attainment, or below-average mathematics attainment) to see if it is possible to generate a simplified solution, still adhering to our consistency threshold, which incorporates more configurations.

In Table 6.10, there is only 1 row which could be considered quasi-sufficient – the row of working-class girls without interested mothers. We can see directly from the table, without the need for fs/QCA output, that this row has a consistency of 0.79.

For paternal interest, the tables generated are, again, very similar. In Table 6.11, we can see that only two rows are quasi-sufficient and these both describe types of boys. The output in Figure 6.4 shows the minimised solution for Table 6.11 which, consequently, shows that the only route to the outcome available is for boys who are not in the working-class and have an interested father. This parallels the result for maternal interest in Figure 6.3.

Table 6.10: Truth Table for maternal interest with outcome measure 'bottom 50% of mathematics achievement'

male	working class	PMT class	maternal interest	number	consistency	quasi-sufficient?
0	1	0	0	173	0.79	yes
1	1	0	0	222	0.73	no
0	0	0	0	19	0.63	no
0	0	1	0	620	0.58	no
0	1	0	1	210	0.49	no
1	0	0	0	31	0.48	no
1	1	0	1	285	0.44	no
1	0	1	0	106	0.42	no
0	0	0	1	72	0.4	no
0	0	1	1	270	0.29	no
1	0	1	1	344	0.2	no
1	0	0	1	96	0.15	no

Table 6.11 Truth table for paternal interest with the outcome measure 'top 50% of mathematics attainment'

male	working class	PMT class	paternal interest	number	consistency	quasi-sufficient?
1	0	0	1	94	0.81	yes
1	0	1	1	332	0.79	yes
0	0	1	1	259	0.71	no
1	0	0	0	42	0.64	no
1	0	1	0	127	0.62	no
0	0	0	1	68	0.56	no
1	1	0	1	266	0.53	no
0	0	1	0	82	0.48	no
0	1	0	1	204	0.48	no
0	0	0	0	27	0.44	no
1	1	0	0	275	0.33	no
0	1	0	0	201	0.26	no

Figure 6.4 fs/QCA output for Table 6.11 with consistency threshold = 0.75

```
                                        raw       unique
                                      coverage   coverage   consistency
                                     ---------- ---------- ----------
MALE*workingclass*PATERNAL INTEREST   0.307832   0.307832   0.793427
solution coverage: 0.307832
solution consistency: 0.793427
```

Table 6.12 Truth table for paternal interest with the outcome measure 'bottom 50% of mathematics attainment'

male	working class	PMT class	paternal interest	number	consistency	quasi-sufficient?
0	1	0	0	201	0.74	no
1	1	0	0	275	0.67	no
0	0	0	0	27	0.56	no
0	1	0	1	204	0.52	no
0	0	1	0	82	0.52	no
1	1	0	1	266	0.47	no
0	0	0	1	68	0.44	no
1	0	1	0	127	0.38	no
1	0	0	0	42	0.36	no
0	0	1	1	259	0.29	no
1	0	1	1	332	0.21	no
1	0	0	1	94	0.19	no

In Table 6.12, the row with the highest consistency is, as in Table 6.10, the row representing working class girls without highly interested fathers. I suggest that this row is not quasi-sufficient, however, and so cannot produce a solution for this table.

The analyses in this chapter are intended to address the first of my research questions (on p57) i.e. is parental interest sufficient for attainment in mathematics for some children and not others. The model employed, to this point, has not provided high enough levels of consistency with sufficiency to provide an answer. I shall now discuss the changes I made in my model that enabled me to address this question more adequately.

In Tables 6.9, 6.10, 6.11 and 6.12 there are many rows where the consistency figures are nearer 0.5 than either 1 or 0. This means that the configurations represented by those rows are almost equally as likely to attain the outcome as not and, hence, I cannot, from a quasi-sufficiency perspective, say much about them. I want to be able to refine the model, by introducing an additional factor, so that a higher proportion of our rows have consistencies nearer either 0 or 1. I assumed that introducing a factor of general ability would create a new truth table with fewer rows around 0.5 and, hence, more rows which could be described as either quasi-sufficient for the obtaining the outcome or for not obtaining the outcome. Adding another factor does, however, give us truth tables with twice as many rows as those above and this, in reducing the number of cases per row, can cause additional analytical problems as a result of limited diversity.

Another revision to the model is the decision to focus on maternal interest only. In doing this, I now work with a revised number of cases (2687) from the earlier model. I choose to specifically examine maternal interest because evidence from my pilot study suggested that, for those of the same generation as the BCS70 respondents, mothers were those responsible for helping with schoolwork. This corresponds to findings in the literature (see Reay 1998a, for example) which suggest that, for working-class families particularly, the traditional family structure (of a working father and a mother in the home) led to mothers being a child's main source of educational support at home.

Revised model and analysis (maternal interest)

Very high general ability

The first crisp ability measure I introduce indicates whether a child is of very-high general ability. In Table 6.13, rows with a '1' in the 'ability (top 5%)' column contain cases in the top 5% of general ability, as measured by the BAS. Setting such a restrictive criterion for ability has exaggerated the effect of limited diversity near the top of the table. More than half the quasi-sufficient rows in Table 5 are remainders and, hence, I can anticipate that the most complex solution and the parsimonious solution will look very different.

Table 6.13: Truth table for maternal interest and the top 5% of general ability with the outcome measure 'top 50% of mathematics attainment'

row number	male	working class	PMT class	maternal interest	ability (top 5%)	number	consistency	quasi-sufficient?
1	0	0	0	0	1	4	1	yes
2	1	0	0	0	1	6	1	yes
3	1	0	0	1	1	19	1	yes
4	1	0	1	0	1	12	1	yes
5	1	0	1	1	1	70	0.99	yes
6	0	0	1	1	1	61	0.93	yes
7	0	0	0	1	1	14	0.93	yes
8	1	1	0	0	1	13	0.92	yes
9	0	0	1	0	1	11	0.91	yes
10	1	1	0	1	1	32	0.91	yes
11	1	0	0	1	0	91	0.82	yes
12	1	0	1	1	0	320	0.75	no
13	0	1	0	1	1	40	0.65	no
14	0	0	1	1	0	267	0.64	no
15	0	0	0	1	0	72	0.54	no
16	1	0	1	0	0	131	0.53	no
17	0	1	0	0	1	16	0.50	no
18	1	1	0	1	0	371	0.49	no
19	0	1	0	1	0	289	0.44	no
20	0	0	1	0	0	78	0.36	no
21	1	0	0	0	0	50	0.34	no
22	0	0	0	0	0	39	0.31	no
23	1	1	0	0	0	377	0.27	no
24	0	1	0	0	0	304	0.22	no

Creation of most-complex and parsimonious solutions

Setting a consistency threshold of 0.75 and excluding all remainder rows gives us the most-complex solution in Figure 6.5. There are three routes to the outcome in this solution but only one of these routes is available to girls (the 2nd term in Figure 6.5). Such girls would have to be in the PMT-class, top 5% of ability **and** have an interested mother. Also, all routes to the outcome require an interested mother and only one does not require being in the top 5% of general ability. A somewhat surprising conclusion from the solution in Figure 6.5 is that it is quasi-sufficient for the outcome to be an intermediate-class boy with an interested mother and not be in the top 5% of ability but not quasi-sufficient for the same type of boy who is in the top 5% of ability. This seems surprising and results like this can occur when large numbers of remainder rows are excluded. This reminds us why we should be wary of accepting such solutions.

The solution coverage figure tells us that our entire solution accounts for approximately 34% of the outcome. Though the number of rows left out in Figure 6.5 is high, the resulting number of cases being excluded (which also obtain the outcome) is not. It is usual for the difference in solution coverage between the most complex and parsimonious solution to be negligible because, often, these solutions differ by only one or two rows which cover very few cases.

Figure 6.5: Most-complex solution for Table 6.13 with consistency = 0.75 (highlighted rows excluded)

	raw coverage	unique coverage	consistency
	----------	----------	----------
MALE*workingclass*MATERNAL INTEREST*ability(5%)+	0.226523	0.226523	0.768856
PMTCLASS*MATERNAL INTEREST*ABILITY(5%)+	0.090323	0.090323	0.961832
MALE*WORKINGCLASS*MATERNAL INTEREST*ABILITY(5%)	0.020789	0.020789	0.906250

solution coverage: 0.337634

solution consistency: 0.820557

The parsimonious solution is shown in Figure 6.6. Because I now have included several remainder rows, we see that this parsimonious solution covers approximately 44% of the outcome as against the 34% covered by the complex solution. I have allowed any remainder rows into the solution which produce a simplification, regardless of their consistency. As in Figure 6.5, there are still three routes to the outcome and only one for girls. In Figure 6.6, however, the route for girls is less restrictive because it only requires that a girl be non-working-class and in the top 5% for ability. Working-class boys no longer need an interested mother to achieve the outcome. Figure 6.6 shows that it is now quasi-sufficient for them to be in the top 5% of general ability.

Figure 6.6: Parsimonious solution for Table 6.13 with consistency threshold = 0.75 (highlighted rows included)

	raw coverage	unique coverage	consistency
	----------	----------	----------
workingclass*ABILITY(5%)	0.136201	0.068817	0.964467
MALE*workingclass*MATERNAL INTEREST	0.289606	0.226523	0.808000
MALE*pmtclass*ABILITY(5%)	0.047312	0.029391	0.942857

solution coverage: 0.392115

solution consistency: 0.837672

Creation of intermediate solution

We have already seen that excluding all remainder rows produces some strange conclusions from a theoretical perspective but including them all can give us an over-simplified view of what is going on in the data. To avoid either of these two extreme scenarios, I need to consider each of the remainders in turn to see whether I can theoretically justify their inclusion into our simplified solution.

We can see from Table 6.13 that row 10 , the row of 32 working-class boys of very high ability with highly interested mothers is quasi-sufficient (with consistency of 0.90) and I would expect intermediate-class boys of very high ability with highly interested mothers (row 3) to do as well or better. I also notice that the row of intermediate-class boys (row 11) with interested mothers who are **not** of very high ability (91 cases and a consistency of 0.82) is quasi-sufficient and I expect that boys who fit this type but are of very high ability will also achieve the outcome. Therefore, I include row 3 which has 19 cases and a consistency of 1. This is an example of an easy counterfactual as I am removing the factor 'ability(5%)'from the first term in Figure 6.4.

I now consider row 7, the row of intermediate-class girls of very high ability with an interested mother (14 cases, consistency 0.93). This time, the only quasi-sufficient row I can consider for comparison is row 1, also a remainder (with 4 cases and a consistency of 1). Taking a different approach, I consider that the equivalent row for boys (just discussed) has been included and using theoretical backing, I suggest that, all other factors being equal, girls are likely to achieve as well or higher in mathematics and so, I include the row of intermediate-class girls of very-high ability with interested mothers (Sammons, Mortimore and Varlaam, 1995).

The rest of the remainder rows are similar to one another in that they all represent children who are either of very high ability or have interested mothers. It may be that children of very high ability are less in need of assistance from parents in order to do well or that a high level of maternal interest can overcome a lack of general ability but I cannot be sure enough about this to include any of these rows in the simplified solution. In summary, then, only those remainder rows representing cases in the top 5% of general ability with interested mothers are included in the intermediate solution.

The intermediate solution is shown in Figure 6.7. The first term now has no ability restriction (as it did in Figure 6.5) meaning that all rows representing intermediate- or PMT-class boys with highly interested mothers are quasi-sufficient. We also see that 'PMTCLASS*MATERNAL INTEREST*ABILITY(5%)' from Figure 6.5 has become the, less restrictive, 'workingclass*MATERNAL INTEREST*ABILITY(5%)' because of the inclusion of the row of intermediate-class girls of very-high ability with interested mothers. Finally, the term 'MALE*WORKINGCLASS*MATERNAL INTEREST*ABILITY(5%)' from Figure 6.5 becomes 'MALE*pmtclass*MATERNAL

INTEREST*ABILITY(5%)' in Figure 6.7 because I have included the row of intermediate-class boys of very-high ability with interested mothers.

The solution in Figure 6.7 does not allow for any routes to the outcome with an uninterested mother, as the solution in Figure 6.6 did. This is because of decisions made above about which remainder rows to include and which to exclude. There is a term in Figure 6.5, namely 'MALE*workingclass*MATERNAL INTEREST', which matches one in Figure 6.6, however, showing that I have achieved the maximum possible degree of parsimony in that term (whilst still adhering to our aforementioned consistency threshold)[38].

The parsimonious solution in Figure 6.6 allows us to make some potentially strong conclusions – namely, that for some children (even those in the working class), maternal interest is not required in order to achieve an above-average score in mathematics. I must be careful when creating solutions which include remainders that I am clear about which remainders are (and should be) included instead of striving for a solution which is the easiest to digest and which could be readily adopted by policymakers. Here, the intermediate solution really does lie between the most complex one and the parsimonious one but, as we shall see in the next example, this is not always the case.

[38] By this I mean, I have produced the simplest solution possible bearing in mind the theoretical considerations raised above and the consistency threshold which has been set.

Figure 6.7: Intermediate solution for Table 6.13 with consistency threshold = 0.75

	raw coverage	unique coverage	consistency
	----------	----------	----------
MALE*workingclass*MATERNAL INTEREST	0.289606	0.226523	0.808000
workingclass*MATERNAL INTEREST*ABILITY(5%)	0.113262	0.050179	0.963415
MALE*pmtclass*MATERNAL INTEREST*ABILITY(5%)	0.020789	0.020789	0.941176

solution coverage: 0.360573

solution consistency: 0.828666

High general ability

Our ability factor, in Table 6.14, now shows which children are in the top 25% for general ability. If I set a consistency threshold of 0.74, I see that there is only one quasi-sufficient counterfactual in Table 6.14.

Table 6.14: Truth table for maternal interest and the top 25% of general ability with the outcome measure 'top 50% of mathematics attainment'

row number	male	working class	PMT class	maternal interest	ability (25%)	number	consistency	quasi-sufficient ?
1	1	0	0	1	1	62	0.95	yes
2	1	0	1	1	1	220	0.95	yes
3	0	0	1	1	1	185	0.85	yes
4	1	0	0	0	1	16	0.81	yes
5	1	0	1	0	1	53	0.81	yes
6	0	0	0	1	1	42	0.81	yes
7	1	1	0	1	1	147	0.78	yes
8	1	0	0	1	0	48	0.73	no
9	0	1	0	1	1	148	0.70	no
10	0	0	1	0	1	36	0.67	no
11	0	0	0	0	1	21	0.67	no
12	1	1	0	0	1	86	0.65	no
13	1	0	1	1	0	170	0.60	no
14	0	0	1	1	0	143	0.48	no
15	0	1	0	0	1	78	0.45	no
16	1	0	1	0	0	90	0.42	no
17	0	0	0	1	0	44	0.41	no
18	1	1	0	1	0	256	0.38	no
19	0	1	0	1	0	181	0.27	no
20	0	0	1	0	0	53	0.26	no
21	1	0	0	0	0	40	0.25	no
22	1	1	0	0	0	304	0.19	no
23	0	1	0	0	0	242	0.17	no
24	0	0	0	0	0	22	0.09	no

Creation of most-complex and parsimonious solutions

As before, I start by creating the most complex version of the solution by excluding all the remainder rows in Table 6.14. In Figure 6.8, we see there are three routes to the outcome for boys and one for girls. The routes for girls require them to be in the top 25% for general ability **and** have an interested mother **and** not be working-class. Note, there is no quasi-sufficient route to the outcome for working-class girls in Figure 6.8.

Working-class boys do have a quasi-sufficient route to the outcome but they must also have a highly interested mother **and** be in the top 25% of general ability. PMT-class boys need only to be in the top 25% of general ability and intermediate-class boys have a quasi-sufficient route to even if they are not in the top 25% of general ability so long as they have an interested mother.

Figure 6.8 Most complex solution for Table 6.14 with consistency threshold = 0.75 (highlighted rows excluded)

```
                                             raw       unique
                                           coverage   coverage   consistency
                                          ---------- ---------- ----------
workingclass*MATERNAL INTEREST*ABILITY(25%)  0.329032   0.137634   0.901768
MALE*MATERNAL INTEREST*ABILITY(25%)          0.076707   0.029935   0.854167
MALE*PMTCLASS*ABILITY(25%)                   0.179928   0.030824   0.919414
solution coverage: 0.442294
solution consistency: 0.870240
```

In Figure 6.9, we see the parsimonious solution which, again, will contain the remainder row if it allows for a simplification. As Figure 6.8 and 6.9 are slightly different, we can see that the remainder row has allowed for a simplification and so has been included in the solution. The term ‘MALE*MATERNAL INTEREST*ABILITY(25%)’ appears in both Figure 6.8 and 6.9 and so has been unaffected by the inclusion of the remainder row (row 4 in Table 6.14).

Figure 6.9 Parsimonious solution for Table 6.14 with consistency threshold = 0.75 (highlighted rows included if leading to simplification)

	raw coverage	unique coverage	consistency
MALE*workingclass*ABILITY(25%)	0.231541	0.040143	0.920228
MALE*pmtclass*MATERNAL INTEREST*ABILITY(25%)	0.124731	0.082437	0.832536
workingclass*MATERNAL INTEREST*ABILITY(25%)	0.329032	0.137634	0.901768

solution coverage: 0.451613

solution consistency: 0.868966

Creation of intermediate solution

Based on my earlier reasoning, since row 4 represents intermediate class boys in the top 25% of general ability without highly interested mothers, I do not include it in the solution. This means that the intermediate solution is the same as the most-complex solution in Figure 6.8. In a situation such as this, where there is only one remainder row, the intermediate solution will match either one of the most-complex or parsimonious solutions created during analysis.

Above-average general ability

I now examine the top 50% of general ability and note, from Table 6.15, that there is only one remainder row again (row 24). I note that I do not expect this row to be included in any simplified solution. This is not because of its very low consistency score but rather because it does not share characteristics with the rows that are quasi-sufficient.

Table 6.15 Truth table for maternal interest and the top 50% of general ability with the outcome measure 'top 50% of mathematics attainment'

row number	male	working class	PMT class	maternal interest	ability (50%)	number	consistency	quasi-sufficient ?
1	1	0	0	1	1	90	0.94	yes
2	1	0	1	1	1	315	0.86	yes
3	0	0	1	1	1	271	0.77	yes
4	1	0	1	0	1	97	0.74	no
5	0	0	0	1	1	64	0.70	no
6	1	1	0	1	1	258	0.69	no
7	1	0	0	0	1	31	0.68	no
8	0	1	0	1	1	226	0.61	no
9	0	0	1	0	1	61	0.56	no
10	1	1	0	0	1	172	0.52	no
11	1	0	1	1	0	75	0.51	no
12	0	0	0	0	1	30	0.50	no
13	1	0	0	1	0	20	0.45	no
14	0	1	0	0	1	153	0.37	no
15	0	0	0	1	0	22	0.32	no
16	0	0	1	1	0	57	0.30	no
17	1	1	0	1	0	145	0.23	no
18	1	0	1	0	0	46	0.20	no
19	0	0	1	0	0	28	0.14	no
20	0	1	0	1	0	103	0.14	no
21	1	1	0	0	0	218	0.11	no
22	0	1	0	0	0	167	0.11	no
23	1	0	0	0	0	25	0.08	no
24	0	0	0	0	0	13	0.08	no

Creation of most complex and parsimonious solutions

To check whether this is true, I construct the most-complex and parsimonious solutions for Table 6.15. I find that both these solutions match each other and so term Figure 6.10 as the 'solution' for Table 6.15

Figure 6.10 Solution for Table 6.15 with consistency threshold = 0.75

	raw coverage	unique coverage	consistency
MALE*workingclass*MATERNAL INTEREST*ABILITY(50%)+	0.255914	0.060932	0.881481
PMTCLASS*MATERNAL INTEREST*ABILITY(50%)	0.345520	0.150538	0.822526

solution coverage: 0.406452

solution consistency: 0.838757

These results begin to give an insight into the possible effects of maternal involvement in education on mathematics attainment. In particular, they have provided some answers to my first research question concerning the effects of parental involvement on different types of children. The key finding is that for girls quasi-sufficient configurations are those indicating a high level of parental interest, high general ability and higher class positions. What I cannot pick out here, of course, is effects due to any differences in type of involvement by class though I might begin to hypothesise such differences could be at the root of these class differences in the effects of involvement. Given a theory of class as presented in Chapter 3 where class differences are marked by differences in levels of capital and, therefore, habituses, I suggest that 'maternal interest' as measured in the BCS70 may be too blunt an indicator and that several different activities with differing levels of success can be subsumed within the term 'maternal interest'. I explore this idea in greater detail in Chapters 7 and 8 but, for now, suggest that even given the broad nature of the maternal interest indicator in the BCS70, there are differences between classes in whether it impacts on attainment or not.

QCA on BCS70 (2004 sweep)

The following QCA results show which combinations of factors are quasi-sufficient for above-average mathematics attainment for the *children* of the original BCS70 respondents. Obviously, not all the respondents have children and, as this data is from 2004, several other participants have since dropped out of the survey. The result is that I am left with 193 cases, of which 104 represent girls and 89 represent boys. The best indicator of parental involvement in this sweep is a question asking whether parents always help with homework. I take a positive response to this as indicative of a high level of parental involvement (because of the word ‘always’ in the question). This indicator is not directly comparable to that in the 1980 sweep of the BCS because it is self-reported whereas the earlier indicator recorded a teacher’s judgement about parental interest. I also note that the earlier indicator aimed to measure interest and so, it is possible that there were parents with high levels of interest who were not practically involved. Lastly, the 2004 indicator does not separate maternal interest and paternal interest (as in the 1980 sweep). I suggest that, as the results so far in this chapter show, there are minor differences between these when examined as an indicator of attainment. This intuitively makes sense because it suggests that the help itself is important and not who gives it. For the following analyses, then, I now do as Ragin (2004) and others do with regard when working with small samples and classify remainder rows as being rows with no cases at all.

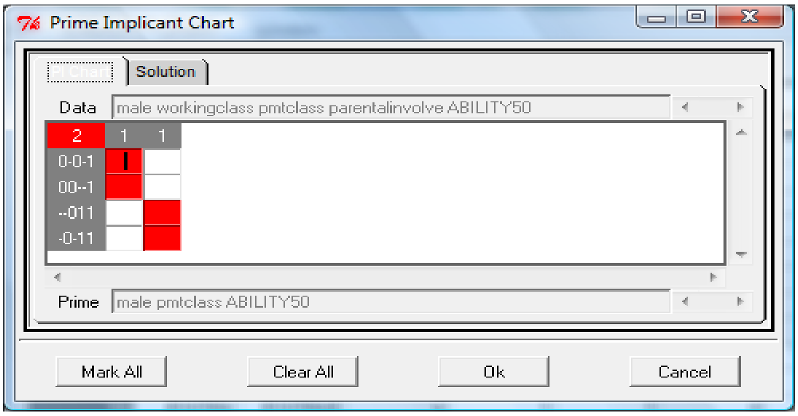
Prime implicants

In Table 6.16, I set the consistency threshold to 0.71 to take into account the large gap in consistencies between rows 11 and 12. This is lower than I would normally select but, as I have argued earlier, selecting the threshold is not a mechanistic process and requires the researcher to group together rows with similar consistencies. Given this threshold, I note that there are several quasi-sufficient rows and attempt to create a simplified solution. In attempting to produce a solution for this table, I find that there is more than one way to simplify the rows being entered into the solution and that choosing which way to simplify will affect what the solution looks like. The fs/QCA software represents this by showing a ‘prime implicant (PI) chart’ and the PI chart for Table 6.16 is shown below in Figure 6.11.

Table 6.16 Truth table for 2004 sweep with the outcome measure ‘top 50% of mathematics attainment’

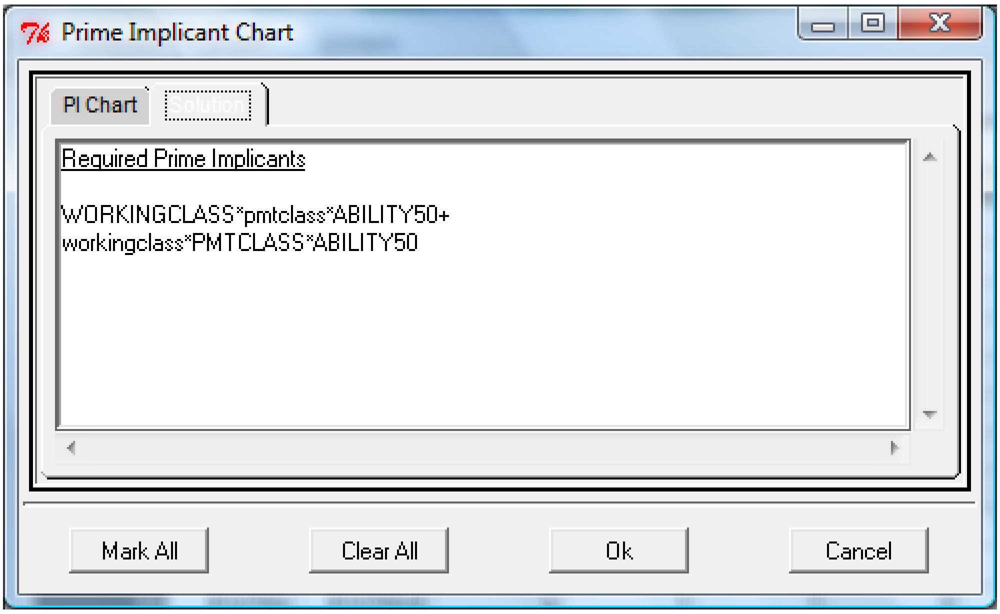
row number	male	working class	PMT class	parental involvement (very high)	ability (50%)	number	consistency	quasi-sufficient?
1	1	1	0	0	1	1	1	yes
2	1	0	1	0	1	1	1	yes
3	0	0	0	0	1	1	1	yes
4	1	0	0	1	1	7	1	yes
5	0	0	1	1	1	7	0.86	yes
6	0	0	0	1	1	6	0.83	yes
7	0	1	0	0	1	5	0.80	yes
8	1	1	0	1	1	18	0.78	yes
9	0	0	1	0	1	4	0.75	yes
10	0	1	0	1	1	20	0.75	yes
11	1	0	1	1	1	7	0.71	yes
12	0	1	0	1	0	28	0.21	no
13	0	1	0	0	0	5	0.20	no
14	1	0	0	1	0	6	0.17	no
15	1	1	0	1	0	26	0.12	no
16	0	0	1	1	0	16	0.06	no
17	1	0	1	1	0	16	0.06	no
18	1	0	1	0	0	2	0	no
19	0	0	1	0	0	1	0	no
20	1	1	0	0	0	5	0	no
21	0	0	0	1	0	11	0	no

Figure 6.11 Prime implicant chart for Table 6.16



A ‘prime implicant’ here is a configuration that cannot be simplified further The “2” tells me that, as well as the required prime implicants shown in Figure 6.12, I need a minimum of 2 additional prime implicants (from those listed in the chart in Figure 6.11) to produce the answer. If I pick more than 2, there will be rows in the solution with no unique coverage (i.e. these rows will be contained in others). The shading in the chart indicates that I need to pick at least one of the first two rows (0-0-1 or 00--1) in conjunction with one of the last two rows (--011 or -0-11) to cover all the all the rows entered into the solution.

Figure 6.12 Required prime implicants for a solution to Table 6.16



To demonstrate all the possible options, I have created the table below (Table 6.17) showing how the required prime implicants (as shown in Figure 6.12) and the optional ones (shown in Figure 6.11) cover all the quasi-sufficient rows in Table 6.16. For example, row 1 from Table 6.16 is covered by just one prime implicant (WORKINGCLASS*ABILITY(50%)) but row 5 is covered by 3 prime implicants.

Table 6.17 Quasi-sufficient rows from Table 6.16 and their associated prime implicants

prime implicants / quasi-sufficient rows from Table 6.16	WORKINGCLASS* ABILITY(50%) [required]	PMTCLASS* ABILITY (50%) [required]	male* pmtclass* ABILITY(50%)	male* workingclass* ABILITY(50%)	pmtclass* PARENTALINVOLVEMENT* ABILITY(50%)	workingclass* PARENTALINVOLVEMENT* ABILITY(50%)
MALE*WORKINGCLASS* parentalinvolvement* ABILITY(50%)	X					
MALE*PMTCLASS* parentalinvolvement* ABILITY(50%)		X				
male*INTCLASS* parentalinvolvement* ABILITY(50%)			X	X		
MALE*INTCLASS* PARENTALINVOLVEMENT* ABILITY(50%)					X	X
male*PMTCLASS* PARENTALINVOLVEMENT* ABILITY(50%)		X		X		X
male*INTCLASS* PARENTALINVOLVEMENT* ABILITY(50%)			X	X	X	X
male*WORKINGCLASS* parentalinvolvement* ABILITY(50%)	X		X			
MALE*WORKINGCLASS* PARENTALINVOLVEMENT* ABILITY(50%)	X				X	
male*PMTCLASS* parentalinvolvement* ABILITY(50%)		X		X		
male*WORKINGCLASS* PARENTALINVOLVEMENT* ABILITY(50%)	X		X		X	
MALE*PMTCLASS* PARENTALINVOLVEMENT* ABILITY(50%)		X				X

I decide, as shown by the shading in Table 6.17, to choose the additional prime implicants 'male*workingclass*ABILITY(50%)' and 'workingclass*PARENTALINVOLVEMENT*ABILITY(50%)' so that the solutions shown in the fs/QCA output will be written in terms of 'not-working-class' children. I argue, given the groups I am interested in and the interview sample to follow in Chapters 7 and 8, that having the terms in the QCA solutions, or routes to the outcome, expressed in this way allows me to see if being working-class stands in the way of high mathematics attainment, even when the children are of high ability or have interested parents (or both). Figure 6.13, shows the fs/QCA prime implicant chart with these selected (where the rows in white are selected) and Figure 6.14 shows the resulting fs/QCA output.

Figure 6.13 Prime implicant chart showing selected prime implicants

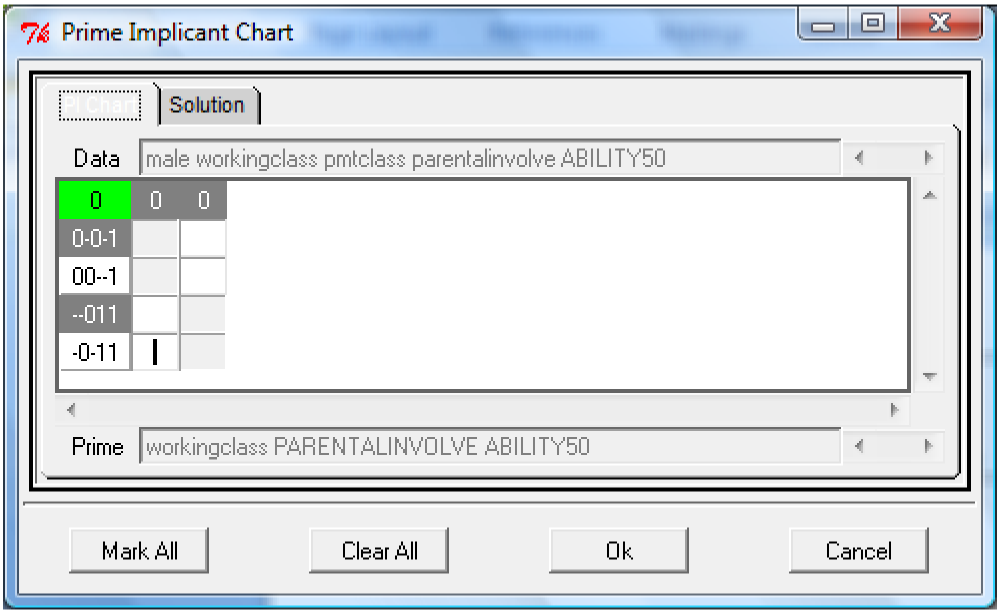


Figure 6.14 fs/QCA output for Table 6.16 with consistency threshold 0.71

	raw coverage	unique coverage	consistency
	--------	-------	--------
WORKINGCLASS*ABILITY(50%)+	0.453333	0.453333	0.772727
PMTCLASS*ABILITY(50%)+	0.200000	0.013333	0.789474
male*workingclass*ABILITY(50%)+	0.200000	0.013333	0.833333
workingclass*PARENTAL INVOLVEMENT*ABILITY(50%)	0.306667	0.093333	0.851852

solution coverage: 0.826667

solution consistency: 0.805195

In Figure 6.14, we see that the terms 'WORKINGCLASS*ABILITY(50%)' AND 'PMTCLASS*ABILITY(50%)' both appear showing that for working-class or PMT-class children, being in the top 50% of general ability is quasi-sufficient for being in the top 50% of mathematics attainment. The term 'male*workingclass*ABILITY(50%)' tells us that, for non-working-class girls, being in the top 50% of general ability is quasi-sufficient for being in the top 50% of mathematics attainment. Intermediate-class boys, by comparison, must be in the top 50 % of general ability **and** have interested parents. So, unlike in the results from the 1980 sweep presented earlier, working-class children do have a quasi-sufficient route to the outcome (if they are in the top 50% of ability) and it is intermediate-class boys who face the most restrictive route to the outcome as they need to be in the top 50% of general ability **and** have interested parents.

I note, however, that the sample used for the above analysis does not have equal numbers of children of each social class category and this may be producing a skewed picture. Of the 193 children, 108 of them are working-class, 31 are intermediate-class and 54 are PMT-class and, as a result, all the rows in Table 6.16 representing intermediate-class children have fewer than 10 cases.

The 2004 results (in Figure 6.14) suggest that, for working-class children, it is possible to attain above-average results in mathematics if the children also attain above-average results in a test of general ability. In other words, this suggests that their class-position is not holding the working-class children back. However, the working-class children could still be doing relatively less well than children from the intermediate or PMT class.

In the next sub-section, I conduct QCA analysis on the interview sample to see if these results are similar to both the QCA results on the 1980 sweep of the BCS70 and the results just presented above.

QCA on interview data

The interview participants were selected to represent various types in the earlier QCA results. In particular, I wanted to explore the different levels of capital present in working-class and intermediate-class parents to see how this impacted on the types of help they were able to give. I derived a parent's score on each indicator using the interview data and so the indicators here are not directly comparable to the earlier analysis but the tables below do show how the parents in the interview sample (and their children) map on to the factors I have discussed in the BCS70 analysis. Table 6.18 below shows the attributes associated with each parent and Table 6.19 shows how the parents in the interview sample map on to the types produced from the BCS70 data.

Table 6.18 Table showing attributes of parents (Generation 1) and their children (Generation 0) in the interview sample using the factors from the BCS70[39]

Parent	Sex of child	Social class (origin)	general ability of parent at age 10	maths attainment at age 10	Social class (destination)	General ability of child	Maths attainment
Joanne	M	int	L	L	int	H	H
Karen	M	int	A	A	int	H	H
Helen	F	int	A	L	working	A	A
Sharron	M	int	H	A	int	A	A
Kirsty	F	working	H	A	int	H	H
Elaine	M	int	A	L	int	L	L
Paula	F	working	A	A	int	A	A
Rachael	M	int	A	A	working	H	A
Irene	F	working	A	A	int	H	H
Ann	F	working	A	L	working	A	H
Clare	M	working	L	L	working	L	L
Mary	M	working	A	H	working	L	L
Victoria	M	working	L	L	working	L	L
Liz	M, F	int	H	H	working	A, H	A, H
Suzanne and Richard	F	working, int	H, A	H, L	int	H	A
Laura	F	int	A	A	int	A	L
Ruth and Peter	F	working, working	H, H	H, H	int	A	A

39 Social class (origin) is the social class of the parent (Generation 1) at primary-school age based on the highest social class position of their parents (Generation 0). Social class (destination) is the highest social class of the parent (or their partner)(Generation 1) at the time of the interview.

Table 6.19 Truth table showing which types parents in the interview sample were at age 10 (based on typology from BCS70 factors)

Male	Working Class	PMT Class	Ability above average	Parental interest very high (for parents when age 10)	Maths Attainment above average	Number of parents	Which Parent(s)
1	1	0	1	1	1	2	Richard, Peter
0	1	0	1	1	1	3	Kirsty, Paula, Ruth
0	1	0	1	0	1	2	Irene, Mary
0	0	0	1	1	1	2	Karen, Sharron
0	0	0	1	0	1	3	Rachael, Liz, Laura
0	1	0	1	1	0	1	Ann
0	1	0	0	0	0	2	Clare, Victoria
0	0	0	1	1	0	2	Elaine, Suzanne
0	0	0	1	0	0	1	Helen
0	0	0	0	1	0	1	Joanne

Figure 6.15 fs/QCA output for Table 6.16 with consistency threshold = 0.75 (where the model is mathematics attainment = fn(male, working-class, general ability, parental involvement))

```
                                  raw       unique
                                coverage   coverage   consistency
                               ---------- ---------- ----------
male*ABILITY*pi                 0.416667   0.416667   0.833333
WORKINGCLASS*ABILITY*PI         0.416667   0.416667   0.833333
solution coverage: 0.833333
solution consistency: 0.833333
```

In my sample, we see that being working-class and of above-average ability and with very high parental interest *is* quasi-sufficient for achieving above-average attainment in mathematics. In the larger BCS70 sample with these factors, we saw that there was no quasi-sufficient route to the outcome for working-class children (see Figure 6.10). A reader worried that this may be fundamentally inconsistent with the BCS70 results should remember that just because a route to the outcome is not quasi-sufficient, does not mean that no cases of that type achieve the outcome. So, it could be that, in this smaller sample, I have located those working-class children who do attain the outcome (of above-average mathematics attainment) but this result would not hold were I to have a larger sample. Though there is a route to the outcome for working-class children, it requires them to have above average general ability and have a parent (or parents) with a very high level of interest.

The factors I use for the QCA on the interview data are designed to match those in the BCS as far as possible. The 'ability' factor here, however, does not relate to the British Ability Scales (BAS) but, instead, to the participant's own judgement of their general ability at primary school. Similarly, the mathematics attainment factor is a self-assessed judgement made by the participant and not the result of an actual test. There is a possibility that this kind of self-assessment could produce bias, in either direction, in the factor. It is possible, then, that parents may have over-estimated or under-estimated their ability. To match with the QCA results from the BCS sample, however, I tried to encourage participants to judge themselves in relation to their schoolmates. Most usually, this information was volunteered during the course of the interview as the participant sought to stress their experience of school or justify the feelings they had about school. In the cases where the information did not emerge in a way which was clear during the course of the interview, I asked participants outright at the end of the interview and recorded this information in a table. In most cases, however, it was not necessary to gather the information in this way and the table served as a checking device instead – allowing me to check that my interpretations of ability and mathematical attainment were acceptable to participants.

Asking participants to think in terms of their position in their own school is problematic, too, since they may have attended a particularly poor or good school. None of these problems invalidates performing QCA on the interview data but does mean that comparisons between the QCA results of the interview data and the QCA results of the BCS should be cautious and mindful of the different nuances conveyed by the factors in each sample.

The remainder rows in this smaller sample, as in the majority of the political science literature, are taken to be those without any cases at all. I also bear in mind that, unlike in the BCS sample, there are no people here in the PMT class. This means that the dummy class factors ‘working-class’ and ‘intermediate-class’ do not both need to be entered into the model since a ‘0’ in either indicates the case is of the other class. One advantage of excluding one of these dummy class factors is that it allows the model to have fewer factors overall but still convey the same information about the cases that are present. So, instead of having 5 factors and 32 possible types in the truth tables, instead, we have 16 rows (representing the types) arising from 4 factors. When the sample size is small, it is usually preferable to have fewer factors in the model as this translates to fewer rows to spread the cases over.

In Figure 6.15, the term ‘male*ABILITY*pi’ suggests that, specifically, for girls, high ability combined with low parental interest leads to above-average attainment in mathematics. The other term, ‘WORKINGCLASS*ABILITY*PI’, suggests that above-average ability children in the working-class with highly interested parents also have a quasi-sufficient route to the outcome. This is a surprising finding because it suggests that the combination of above-average ability and highly interested parents only leads to the outcome of above-average attainment in mathematics if the child is working-class. Earlier, I suggested when constructing intermediate solutions (in, for example, Figure 6.7) that I expected the combination of ability and parental involvement to lead to the outcome for intermediate class boys.

We must remember, however, that this sample is heavily skewed towards women. There are only 2 men in the sample and only one of these reported very high involvement from parents (Generation 0). Further, a number of the women interviewed believed their parents (Generation 0) were less interested in their mathematical education because of generational attitudinal differences towards the education of women. These women indicated that they were encouraged, in some cases very strongly, to pursue other subjects, for example, related to secretarial work. Participation rates in GCSE level mathematics show that, while the gap has decreased over time, fewer women than men study mathematics in contemporary schools (Brown, Brown, & Bibby, 2008).

We could conclude, then, from the interview data, that it is not an absence of parental involvement that leads to the outcome for high ability girls but that these girls succeed in spite of having low levels of parental involvement. There are, however, [a number] of women interviewed who said their parents would not have been able to help because of their low levels formal education. Using this, we might then even wonder whether an absence of parental involvement is an essential part of their success because any help they did receive could have been of low quality. In a study by Abreu and Cline (2005), parents from outside the UK provided help based on their knowledge of foreign curricula and, therefore, their children were sometimes better receiving no help from home.

The best way to check whether a low level of involvement is crucial to the success of the women in my sample is to perform QCA on the sample of women only. Thinking back to how the process of minimisation in QCA works, I note that removing the sex term in the model could lead to a simplified picture. In Figure 6.19, we see that performing QCA on the women-only sample has produced a solution with 2 terms which both include the presence of the ability factor. The first term, 'ABILTY*pi', is, as I predicted, giving us the same information as the first term of the solution in Figure 6.18 (i.e. male*ABILITY*pi) and shows that the presence of the two male cases is not distorting that term. The second term, 'WORKINGCLASS*ABILITY', is, however, different from its counterpart in Figure 6.18 because it makes no restriction on the factor 'PI' and, instead, shows that, for the women in this sample, the conjunction of being working-class and having above-average ability is sufficient to attain the outcome.

The solution in Figure 6.16 does pose some interesting questions, however. The most obvious one is why the only route to the outcome for intermediate-class children is to be of above average ability and have parents *without* very high levels of interest. It is worth, here, examining the associated truth table to see how this simplification has arisen and if it is justified.

Figure 6.16 fs/QCA output for women only with the consistency threshold = 0.75

```
                              raw        unique
                              coverage   coverage   consistency
                              ---------- ---------- ----------
ABILITY*pi                    0.500000   0.300000   0.833333
WORKINGCLASS*ABILITY          0.500000   0.300000   0.833333
solution coverage: 0.800000
solution consistency: 0.800000
```

In Table 6.20, we can see that the top 3 rows have consistencies which are above (or equal to) 0.75 and so we can say these appear to be quasi-sufficient rows. These, together, represent 10 cases, 8 of which attain the outcome. The 4th row, highlighted in red, has a consistency of 0.5 meaning that it sits at the point of maximum ambiguity for consistency. That is, it is neither sufficient nor insufficient. If this row were quasi-sufficient, there would be no difference by class in the solution and it would contain only 1 term, namely 'ABILITY'.

Table 6.20 Truth table for women only with consistency threshold = 0.75

working class	ability	parental interest	number	consistency	quasi-sufficient?
1	1	0	2	1	yes
1	1	1	4	0.75	yes
0	1	0	4	0.75	yes
0	1	1	4	0.5	no
1	0	0	2	0	no
0	0	1	1	0	no
0	0	0	0	n/a	n/a
1	0	1	0	n/a	n/a

Obviously, here, I have a small sample of all the possible cases of each type in the truth table and so I have to consider that limited diversity may be skewing the results of the QCA. The first thing to note is that the red row has the joint highest number of cases of any row in the table and that deciding to alter its position in the table would have consequences for all the other rows. Secondly, the simplification that would be produced by declaring this row as quasi-sufficient would be very stark and would suggest the presence of a single sufficient condition in the data.

Figure 6.19 shows the routes to the outcome **for these cases.** Since this sample is so small, it would be dangerous to make strong claims, in respect of my research question concerning parental interest **.** Qualitative work in this broad area, such as the work of Lareau (1987) or Crozier (1999), suggests that parents in the intermediate class are better equipped to help and that the help they give most usually matches the curriculum so it does seem odd that a lack of parental involvement appears in the term for intermediate-class children. We must, however, remember that that intermediate class is considered the least homogeneous of all the social classes because it encompasses both manual and non-manual workers and is the least stable of the social classes because more people move into and out of it than any other class (Goldthorpe, 1987)[40].

In Table 6.21, I create a truth table showing the characteristics of the children in the interview sample. Where a parent has more than one child, that parent's name appears twice. All the parents in the interview sample were identified by teachers as having high levels of interest (in a similar way to the 1980 BCS70 question about parental interest) and so that column is only included for completeness.

The fs/QCA output in Figure 6.17 suggests that general ability is quasi-sufficient for above-average mathematics attainment, given high levels of parental involvement, for children of any class. This seems like an equitable outcome and implies that children of any social class can attain highly regardless of their social class if they have interested parents. I suspect, however, that this simplistic solution obscures some of the class differences in the type of involvement given because of the different levels of capital possessed by different parents. I explore this further in Chapters 7 and 8 by analysing the interview data more thoroughly.

[40] It is worth noting here that Goldthorpe (1987) talks almost exclusively about the social class positions of men in his earlier works because he uses datasets where there was only information about men. Here, I construct family class position from the parent with the highest class position and so talk about 'people' rather than 'men'.

Table 6.21 Truth table showing types of children in the interview sample at age 10

Male	Working Class	PMT Class	Ability above average	Maths Attainment above average	Parental interest very high	Children of
1	1	0	1	1	1	Rachael, Liz
0	1	0	1	1	1	Helen, Ann, Liz
1	1	0	0	0	1	Clare, Mary, Victoria (x2)
1	0	0	1	1	1	Joanne, Karen, Sharron
0	0	0	1	1	1	Kirsty, Paula, Irene, Suzanne and Richard, Ruth and Peter
0	0	0	1	0	1	Laura
1	0	0	0	0	1	Elaine
0	0	0	0	0	1	Joanne

Figure 6.17 fs/QCA output for Table 6.19 with consistency threshold = 0.75 (where the model is mathematics attainment = fn(male, working-class, general ability))

```
                 raw        unique
               coverage    coverage   consistency
              ----------  ----------  ----------
ABILITY       1.000000    1.000000    0.928571
solution coverage: 1.000000
solution consistency: 0.928571
```

Summary

I have shown, in this chapter, that parental involvement appears to be having different effects on mathematics attainment for different types of children at different points in time (but I note that only one of these points in time has a large-n sample size). I consider the rows in the QCA to be representative of different types and aimed to distinguish between these types to see which were consistently sufficient for mathematics attainment. I used longitudinal data from the BCS70 dataset to analyse mathematics attainment in 1980 (when the respondents to the BCS70 were 10 years old) and in 2004 when their children were at primary school.

I started by showing how, using QCA, I created a model for mathematics attainment with the factors sex, social class and parental involvement. I investigated several different levels of attainment to see if any configurations of these factors were quasi-sufficient and found that this model did not differentiate between configurations and most rows were neither quasi-sufficient nor insufficient for mathematics attainment.

I then refined the model to introduce a factor of general ability which I anticipated would greater differentiate between types in the model but would lead to model with limited diversity. I showed how to overcome this limited diversity in the analysis by using counterfactual reasoning, as explained in Chapter 5. Focussing on maternal interest, I produced results which showed that maternal interest is sufficient for mathematics attainment for some types of children and not others. For girls, particularly, parental involvement is not sufficient to lead to a high standard of attainment unless the girl in question is of a high social class and high general ability.

I then used the 2004 data to compare these results for parents to that of their children. For these children, class differences were less marked and differences between sexes had reversed over time to provide more favourable outcomes for girls. I suggested that this may not be an accurate reflection of class differences that do still exist in parental involvement and, in the following chapters, I explore this in more detail.

Finally, I performed QCA on the interview data as a precursor to Chapters 7 and 8 to see whether the results for my (small) interview sample reflect the broader results show so far in the chapter. I showed that, for parents (Generation 1), it was quasi-sufficient for above-average mathematics attainment to be an above-average ability girl with not highly interested parents or to be a working-class child of above-average ability with highly interested parents. I suggested, however, that the high ratio of women to men in the sample was presenting a skewed picture and analysed the data for women separately. This analysis showed that it was quasi-sufficient for above average mathematics attainment for girls to be of high-ability with not highly interested parents or to be working-class and of above-average ability.

I have theorised, in Chapter 3, that different parents may be differently able to help their children with mathematics because of their differing access to types of cultural capital and the effects this has on their habituses. In the following chapters, by examining cultural capital and parents' access to it, I examine whether parental involvement in mathematics does differ by class and subsequently means that different parents are differently able to help their children.

Chapter 7 – Parents and Cultural Capital

In this chapter, I analyse interview data from 19 parents whose children attend one of 6 different schools. I build on the work in Chapter 3, with particular reference to the idea of 'institutionalized capital', to explain some of the QCA results in Chapter 6. In the previous chapter, I showed that, for some children, a high level of parental interest was not sufficient to lead to high attainment in mathematics. The results showed a difference between social classes and sexes for the 1980 sweep of the BCS70 data and between social classes in the 2004 sweep of the BCS70 data. This suggests that there may be a difference in the kind of parental help offered by parents of different social classes (and, in the 1980 sweep, a difference in the help offered to children depending on their sex). I investigate, in the interview data, whether levels and composition of capitals can provide an explanation for these differences. In particular, I want to try and provide case-based answers to the questions:

- What do parents do to help their children with primary school mathematics?
- Why is parental help in primary school mathematics (perceived as) successful in some cases and not in others?
- Who do parents choose to help their children with primary school mathematics, if not themselves?
- How is this person selected to help?

I tackle the first two of these questions in this chapter and the other two in Chapter 8, where I explore parents' use of social capital to source help for their children with primary school mathematics. Firstly, however, I summarise below, in Table 7.1 and Table 7.2, some characteristics of the schools attended by the children of the parents in the sample.

Table 7.1 List of interview participants and their associated schools

Parent	School
Joanne	Bankhill Primary
Karen	Bankhill Primary
Helen	Bankhill Primary
Sharron	Churley Park Primary
Kirsty	Oscar Road Primary
Elaine	Oscar Road Primary
Paula	Oscar Road Primary
Rachael	Oscar Road Primary
Irene	Oscar Road Primary
Ann	Oscar Road Primary
Clare	Oscar Road Primary
Mary	Oscar Road Primary
Victoria	Hunter Road Primary
Liz	Glen View Primary
Suzanne and Richard	Rutherston Primary
Laura	Rutherston Primary
Ruth and Peter	Rutherston Primary

Table 7.2 School characteristics

School	Location	Social-class composition	Size	Ofsted Rating
Rutherston Primary	small town	mainly working-class	large	Good
Glen View Primary	small town	mainly working-class	medium	Good
Bankhill Primary	rural area	mixed	medium	Inadequate
Hunter Road Primary	urban area	mainly working-class	small	Good
Churley Park Primary	rural area	mixed	very small	Good
Oscar Road Primary	small town	mixed	large	Outstanding

The interviews were conducted in schools or the houses of participants and were semi-structured. All the participants were interviewed individually except for Ruth and Peter and Suzanne and Richard; both couples who asked to be interviewed together. All names used throughout are pseudonyms. Before conducting the analysis, I expand on the theory of capitals from Chapter 3 and introduce definitions of some specific capitals that I looked for in the data.

The sampling strategy employed in this study is theoretical sampling because I have chosen specific types from the analysis in Chapter 6 for further investigation. All the parents had been identified by their children's primary schools as having high levels of interest in their children's education. I chose to restrict the investigation to those parents with high levels of interest so that I could analyse differences in types of involvement and its impact on attainment and/or understanding. I also selected participants with different social class backgrounds, sexes of children and a range of abilities of children so that I could cover several dimensions of the typology generated in Chapter 6. I also engaged in snowball sampling by asking teachers and participants themselves if they could recommend others, of a particular type, who would be willing to be interviewed.

I note, here, Glaser and Horton's (2004) point that theoretical sampling is different to other methods of sampling because the researcher will be analysing collected data with a view to deciding what the next relevant avenue is for data collection. The results and discussions here represent one iteration of what could be an ongoing process of performing QCA on a large dataset, selecting types to interview, analysing the interview data and refining or revising the QCA model or performing a different analysis and starting the whole process again.

Snowball sampling is not without problems but I note here that I made limited use of it and that, by employing a theoretical sampling strategy overall, I was able to alleviate the obvious difficulties that arise from its use. For Coleman (1958), a snowball sample allows access to a natural group of people and it was for this reason that I employed this sampling strategy in conjunction with theoretical sampling. With no links to schools myself, I found it difficult, at the beginning of the project to secure cooperation with schools and then their associated parents. After interviewing parents, I found that they were interested in the project and recommended other parents I could talk to who were ‘like them’. I was, because of my concern that the participants be sampled theoretically, able to check with them what they meant by ‘like them’ and, therefore, check that those they recommended had the characteristics I was interested in.

Biernacki and Waldorf (1981) suggest that relying on these ‘referrals’, as they term them, may result in a number of ‘false starts’ i.e. situations where, once contacted, the potential participant is found to be ineligible or unwilling to participate. In my study, in fact, some potential participants suggested to me chose not to be part of the project. Relying on snowball sampling could be an inefficient way to reach those participants you are interested in but, if employed in conjunction with other sampling methods, could, as in my case, lead to extra participants that may have proved difficult to contact directly.

Another typical problem of snowball sampling is producing a biased sample from which it is not possible to make rigorous generalisations about research findings on a wider group of people. Again, my aim to select particular people through the use of theoretical sampling means that, though my sample is not representative because, for example, it only includes interested parents, this is deliberate and allows for more thorough examination of particular types of cases.

Relevant forms of capital and how they are measured

In this chapter, I focus on three specific types of cultural capital that I suggest are employed when parents help their children with mathematics. I decide to frame the analysis in terms of cultural capital (and, later, also social capital) to help me pick apart the value that educational qualifications and knowledge of the education system as well as specific subject knowledge hold in a specific area of the educational marketplace. By considering these as types of capital, however, I can conceive of their value being transferred – particularly to another person. It is this transference to another person, from a parent to a child that I examine here.

I discussed, in chapter 3, some different forms that cultural capital can take and how these are useful to examine in a study of parental involvement in mathematics. In Chapter 1, I showed that mathematics has always held a prominent role in social selection and job prospects and so is, what I term, a ‘high-stakes’ and, therefore, important school subject to do well in. Not only does mathematics occupy a privileged place in the general school curriculum but also, as I discussed in Chapter 2, the mathematics curriculum specifically favours and legitimises certain sub-sections of knowledge within mathematics. I introduced the term, in Chapter 3, ‘institutionalized capital’ to describe this form of official knowledge, gained through formal learning and argued that, though this form of capital is indexed by qualifications, it is possible to possess institutionalized capital even with no qualifications to indicate this. I also discussed how institutionalized capital is not a fixed concept and how, for example, curriculum reforms can erode the current value of older forms of institutionalized capital a person has even if that person does hold qualifications. This is particularly important to bear in mind when thinking about the utility of a parent’s qualification in mathematics for helping their struggling child.

Within primary school mathematics, I investigate three main types of cultural capital where I suggest that the institutionalized form of capital is more useful to the non-institutionalized form. I note here that I consider ‘types’ of cultural capital to describe specific areas of skill or knowledge and ‘forms’ to indicate the structure of the capital relative to a given context. For example, within the English schooling system, a teacher with a teaching qualification from abroad may be considered to have non-institutionalized skills and knowledge.

In order to theorise this idea of 'context', I draw on Bourdieu's concept of 'field' and use it to determine what constitutes institutionalized capital in any given situation. A field is a 'structured space of positions… that imposes its specific determinations on all who enter it' and thus represents a small section of society where interactions between people take place subject to, for example, a particular hierarchy or set of rules (Wacquant, 2006). I primarily examine, in this thesis, interactions between parents and children in the field of primary school mathematics, in two different time periods, and thus across at least two fields. I suggest that problems with parents helping children occur when parents possess capital (or combinations of capitals) in a form that is incompatible with the specific institutionalized capital required. The difficulties they face, I suggest, can be related to content of the curriculum, the methods used to teach it and the terminology associated with primary school mathematics.

To aid with analysis, I define three types of cultural capital held by parents and look at attempts made to raise these levels of capital and transfer capital from parents to children whilst, at the same time, considering whether parents' levels of capital are in the institutionalized form within the field of primary school mathematics. I specifically focus on 'mathematical' capital, 'pedagogic capital' and 'linguistic capital' and will frame the analysis around these types later in the chapter. After defining these types below, I also consider questions such as whether it is sufficient, in some cases, to have a high level of only one of these types in the institutionalized form or whether one or other of the types is sufficient for successful help to occur.

I attempt to create a framework for analysis of episodes of parental involvement in mathematics by identifying some specific types of capital held by parents, locating these within the three types of capital and discussing, for example, whether prohibitively low levels of some types of capital may prevent parents from helping their children. I also consider whether very high levels of certain types of capital are sufficient for enabling help to be given. Thinking in terms of configurations of levels of capital allows for a detailed analysis of how attributes in parents inter-link to facilitate or hinder involvement. Framing parental involvement as transmission of capital from parents to children means I focus on some specific types of capital associated with transferring capital but accept that this is only a partial treatment of all the types of capital that may be present in parents.

Mathematical capital

I define, firstly, mathematical capital as an indicator of what parents know about mathematics. A high level of mathematical capital indicates competence in mathematics and knowledge of mathematics. Mathematical capital can be measured by formal qualifications in mathematics or through a practical display of competence, for example in a work-place. Mathematical capital, like other forms of cultural capital, is tied up with other forms of capital – such as linguistic capital – which allow for it to be acquired and transmitted and will be deployed most successfully when levels of these related capitals are not prohibitively low. As a researcher, it is obviously easier to obtain information about a research participant's qualifications than it is to observe them carrying out mathematical activity in the workplace. A qualification is, ostensibly, an objective indicator of competence whereas informal mathematical activity is subject to subjective assessment by the researcher. As my data was collected by interview, it was only possible to obtain a participant's perspective on any informal mathematical competence they had which was not reflected by their formal qualifications. This is where levels of confidence are important to consider. We could imagine a parent who is confident in mathematics being happy to highlight any achievements whereas someone who is less confident may denigrate their achievements.

In practice, I have, then, measured mathematical capital by considering qualifications gained in mathematics, both at school and afterwards, and taken note of any exceptional instances of mathematical activity in a person's job or social life. It is important to consider qualifications at various stages of a person's life in order to attempt to account for fluctuations of levels of capital over time. There are those who would suggest that the content of qualifications in the UK has changed to such an extent that a O-level, say, taken 30 years ago, contained more mathematical content, i.e. more to learn, than a modern-day GCSE even though they are often posited as equivalent qualifications[41]. We could imagine that someone who once possessed a certain level of mathematical capital may find their levels of it decreasing over time if they are not engaging in mathematical activity regularly. We could also imagine a person making an effort to improve their mathematical knowledge later in life and, hence, increasing their levels of mathematical capital. I try to unpick this in the interviews through comparisons of current mathematics and parents' memories of their mathematical learning.

Pedagogic Capital

Pedagogic capital is knowledge of the education system and skills in education. Someone with a high level of pedagogic capital may, for example, be a current teacher. As with mathematical capital, this can be gained (and, hence, measured) through formal qualifications and also informally. A particular example of informal pedagogic capital, and one I will explore at greater length later in this section, is a mother, with several children, gaining knowledge of the education system through her experiences with the eldest child. Not all parents with several children will necessarily be able to do this. Again, informal pedagogic capital is undoubtedly harder to measure but indicators of it

[41] For more on the comparisons between modern GCSE's and O-levels in mathematics, see, for example, Hodgen et al (2009).

include evidence, like the above example, that a parent understands the curriculum or a teaching method without having been formally instructed.

I hope that by separating mathematical and pedagogic capital, I am able to examine which (if either) is being transmitted and converted to mathematical capital in the child and if it is possible for a parent to transmit their mathematical capital successfully if they have low levels of pedagogic capital. I note here that we can conceive of cases where capital has not been obtained with the purpose of transmission to the child but for status purposes, a form of 'symbolic capital' (Bourdieu, 1986). In essence, most types of capital are symbolic as well as practical but, here, I use the term to indicate the accumulation of capital which is gathered for its own sake, either without the intention to transmit or capital which is not transmitted. Even when using the term symbolic capital, I still distinguish the nature of the symbolic capital by indicating whether it is social or cultural. For example, we could imagine a parent of a low social class position who boasts of her professional friends to others yet never calls on these friends for favours and thus accumulates symbolic social capital. Similarly, we could imagine a parent who gains a qualification later in life to prove to others that he is capable of it and thus accumulates symbolic cultural capital, an example borne out in the interview data. Note that I still categorise these two instances as examples of *capital* accumulation because, in theory at least, the social contacts and educational qualifications do have some potential value in some marketplace. They *could* be transmitted or exchanged but, in these cases, are not.

Linguistic Capital

A high level of linguistic capital indicates, here, the ability to articulate mathematical concepts using precise language. I consider this separately from pedagogic capital and mathematical capital in an attempt to isolate terminological difficulties parents face and not conflate these with difficulties faced understanding the mathematical concepts themselves or the methods used to teach them. I examine later, in the interview data, whether parents find the current language of primary mathematics confusing but can extract the concepts and communicate those to their children. To be able to do this, I suggest that they may need a high level of another (or several other) forms of capital, such as mathematical capital or pedagogic capital.

Zevenbergen (2000) suggests that mathematical language is a specialised form of language with three specific characteristics. Firstly, the language of mathematics is very specialized and often words take on a different meaning in a mathematical context than they do in general discourse. Tapson (2000) suggests that it is often left to the student to deduce the intended meaning when a word appears in a mathematical context but has a more well-known common meaning. Secondly, the semantic structure used in mathematical word problems is different from that which would be used outside of mathematics (Zevenbergen, 2000). Here, Zevenbergen (2000) argues that, in order to incorporate unknowns into a word problem, the semantic structure is altered so that it no longer resembles natural speech or standard sentence construction. This can make it difficult to interpret for pupils without strong lexical skills or, in other words, without a high level of linguistic capital. Thirdly, mathematical language is, Zevenbergen (2000) suggests, lexically dense. Zevenbergen (2000) applies this notion, borrowed from Halliday (1974) to suggest that mathematical language contains more concepts per clause than standard linguistic exchanges. This can provide a further barrier to understanding as meanings of particular phrases or words are must be known and cannot be assumed.

As I noted in Chapter 3, the work of Bernstein is useful when theorising about linguistic capability. I suggest, noting the above points about the sociolinguistic qualities of mathematical language, that linguistic exchanges in mathematics use, what Bernstein (1964) terms, ‘elaborated codes’. A predisposition to using elaborated codes should, therefore, help a person to communicate and understand mathematical ideas better. As Dowling (1998) notes, those people oriented to use of restricted codes gain understanding through context-dependent situations. These people may find communicating mathematical ideas difficult. I examine the problems some parents have with mathematical language and communicating mathematical ideas to their children in an attempt to understand whether, in each case, the parents lack mathematical capital or the linguistic capital needed to transmit it.

Accumulation and transfer of cultural capital

Bearing in mind the different types of cultural capital discussed above, it is possible that in the context of primary mathematics, some forms of cultural capital may be more useful when helping with homework than others. There are a diverse range of examples of accumulation and deployment of cultural capital by the parents in this study. As I will discuss in detail later in this chapter, there are many parents who have sought to raise their levels of cultural capital with the specific aim of transmitting that capital to their child. There are also some parents who have found they are better able to help as a consequence of capital-raising activities they undertook for another purpose. The result is that, for many people in the study, their levels of mathematical capital are not stable. Some report feeling that their levels have dropped over time and some, as just mentioned, make specific attempts to increase their levels, often after doing poorly at the subject in their own school careers. I organise the analysis into two sub-sections below by, firstly, focussing on the help given from grandparents (Generation 0) to parents (Generation 1) in the study[42]. This ties in most closely with the QCA work in Chapter 6 on the BCS70 1980 sweep. I, secondly, examine (in more detail) the help given by parents (Generation 1) in the study to

[42] I use the same generational indicators with the interview data (e.g. Generation 1) as with BCS70 data to avoid confusion.

their children (Generation 2). This sub-section of analysis is more detailed because the parents are answering questions about their own involvement and I am able to probe more about specific instances of help or any problems being faced by the parents when trying to help. This section is also more detailed because, as I show below, most parents in my sample either did not receive a great deal of homework at primary school or cannot remember much about homework in primary school. The focus on the help parents in the study give to their children is more recent and I am able to analyse more detailed descriptions of, for example, the particular courses taken by parents with a view to helping their children or specific strategies for helping.

When examining the contemporary context, I, firstly, try to unpick, using some specific examples, why some instances of parental involvement seem successful and some are not successful. I hope this analysis will allow me to explain why not all parental involvement necessarily leads to high attainment, a key finding in Chapter 6. I then examine some parents' attempts to raise capital through attendance at courses and workshops. I suggest that, because they offer access to institutionalized pedagogic, mathematical and linguistic capital, courses in schools should provide parents with an increased ability to help. I compare two such courses and discuss whether the institutionalized nature of the capital transferred in them causes parents to feel uncomfortable when attending such a course.

Grandparents (Generation 0) helping parents (Generation 1)

For most parents (Generation 1) in my sample, homework was not a regular feature in their primary schooling. The answers given about the help they received at home are, therefore, sometimes in relation to homework in secondary school. I aim, through these answers, to ascertain how the parents (Generation 1) selected someone to help them with mathematics and, in particular, if any of the types of capitals explored earlier are seen as better indicators, for them, of who will be able to provide help.

I split the analysis in this sub-section into parts with the first of these examining what the differences are between types of help offered by grandparents (Generation 0) and the success of these. I then examine, in which cases the parents (Generation 1) decided to avoid asking for their parents (Generation 0) help and provide examples of two cases where this happens but the circumstances are different. This helps me to unpick why different parents have varying degrees of success when involving themselves with their children's school mathematics and helps to explain why some of the results in Chapter 6 occur. Finally, I use two cases to propose an explanation for the different results in Chapter 6, by sex.

The reader will find it helpful to refer back to two tables while reading the following section. Table 6.19 (p140) provides information from the parents' early years organised by configurational type on the parents interviewed. The names of the parents appear in the final column. Table 6.21 (p147) provides information on the children of these parents, again organised configurationally. Once again, the parents' names are provided in a final column in order that this can be used as a look-up table whilst reading the interviews.

Different types of help offered by grandparents

In my sample, 6 of the parents (Generation 1) classed at least one of their parents as being very good at mathematics or, as I term it, high in mathematical capital. One of these, Ann, recalls that her father would help her with homework but using his own methods and her teacher could tell she had had help.

Ann: He did it his way and when it come to get marked at school, my teacher knew I didn't do it and it was him that actually showed me how to do it, his way.

Interviewer: And did you ever find that his way was easier for you to understand?

Ann: I did, yeah. Yes, yes, I did.

Ann, working-class, Oscar Road

If we assume, as implied by Ann, that her father simply used another method and did not get the question(s) wrong then the father of Ann did not have the institutionalized capital required (perhaps because his institutionalized capital was out of date) to explain to her how to do the homework with the school's method but still had high enough levels of mathematical capital and pedagogic capital to explain another method to her. If, however, the teacher was not querying the presentation but both the method used **and** the answer given, then Ann's father lacked high enough levels of mathematical capital to help her. Either way, there is an absence of any type of institutionalized capital. So, Ann has a father keen to help but without the levels of capital to make that help successful. This analysis hinges on perceiving the field as primary school mathematics and, therefore, success in this field as indicated by, for example, high test scores and homework being marked as 'correct'. So, the definition of success is very narrow and relates only to the recognised indicators within this field. If the field was widened to 'mathematics', the father of Ann could be considered to have provided successful help to his daughter because she claims to understand the material better than without his help.

Another mother in the study, Elaine, received help from her father who was a mathematics teacher and so, from a parent with high institutionalized mathematical and pedagogic capital. She recalls that his help was not universally successful.

He tried to help me, yeah. He's a supportive dad. He did try. I didn't always understand but he did try and help… I think I just had a mental block when it came to maths. Because trigonometry, I would… He would explain it to me and I would be all right on the first few questions and then I would get stressed, you know? It's probably the subject that I was always the most fearful of because I loved school apart from maths.

Elaine, intermediate-class, Oscar Road

It is clear here, then, why a typological approach is useful for examining parental involvement in mathematics. Elaine indicates that she lacked confidence in mathematics and, earlier in her interview, also states that struggled with the subject throughout school. Thus, it could be that, for children with low confidence or low mathematical capability, parental help will not enable them to attain highly. Certainly, Elaine's father has high levels of mathematical capital and pedagogic capital and both of these in an institutionalized form but, for a child (as she was then) like Elaine, even this combination of highly relevant capitals is not sufficient to allow her to attain highly.

When grandparents were not called upon to help

A contrasting situation to that of Elaine was expressed by Liz who chose not to ask her parents for help because she considered herself competent enough to complete homework on her own.

I was quite clever at most things at school and I found it that easy that it literally was, come in when you've finished playing, sit down, rattle it off, as quick as you can and that was it.

Liz, intermediate-class, Glen View

Liz's description fits with the QCA results in Figure Chapter 6 which show that children who attain above-average in mathematics without parental help tend to be those of high general ability and not working-class. What the QCA results in Chapter 6 cannot tell us is if parents of such children would be capable of helping, if their child required it. In the case of Liz, she identified her father as good at mathematics and her mother as less so and considered that she could approach either if she had been stuck. For Mary, another parent who found mathematics easy at school, however, asking her parents was not something she considered doing.

Mary: It didn't matter which subject I had a problem with, I always went to school and asked them to help me out.

Interviewer: Do you think that's because you thought your mum and dad wouldn't be as forthcoming or be able to explain it as well or?

Mary: I think it was because: 1) they were always too busy and 2) I don't think they would've been able to explain as good or work around, an easier way round it as my teacher.

Mary, working-class, Oscar Road

In this case, Mary has chosen not to ask her parents because she perceives that they lack the pedagogic capital to be able to explain it to her. For Mary, asking about homework is perceived as adding to her parents' already busy lives. This was a theme throughout the interviews from many parents (Generation 1) who were working-class in childhood. They felt that homework was solely their responsibility and that questions about schoolwork were to be asked in school. As I show in the later section covering modern schooling, many parents are less passive now about their children's schooling and will actively engage in learning and activities at home with their children even if the child does not request help.

An explanation for differences in parental involvement towards mathematics for girls

Finally, another generational difference was expressed by both Sharron and Laura. In the QCA results in Chapter 6, we saw that, for intermediate-class girls, even the configuration of high general ability and very high parental involvement could not produce consistent high attainment in mathematics. Sharron remembers her parents having the expectation that she would not pursue an academic route.

Sharron: I think they saw the value in me doing it but they never really expected, they wouldn't have driven me academically because, you know, there wasn't the expectation of me to do that well really.

Interviewer: Do you think that was just because of their experiences of school or...?

Sharron: Well they both left school at 15 and basically didn't do any further study. And, as I say, I don't think they particularly valued especially, I know this sounds very, you know, but it was a long time ago, and I don't think they expected a girl to go that much further.

Sharron, intermediate-class, Churley Park

So, for Sharron, there was not strong encouragement to perform at a high level, academically, in general because her parents thought academic studies were mainly a male arena. In the case of Laura, there was a high level of parental input into her education from her parents but with regard to subject choice.

Interviewer: What subjects did you, when you got the choice to study subjects in secondary school, which ones did you pick to do?

Laura: I didn't have a choice, my parents told me what to do. So, it was a case of, women only did secretarial duties, so you had to do typing and shorthand.

Laura, intermediate-class, Rutherston

Both these cases may be indicative of more general societal attitudes towards girls and mathematics in the past. As Walkerdine (1988) notes, the differences in attainment between girls and boys in mathematics have often been over-emphasised leading to the widespread perception, in the past, that girls were worse at school mathematics than boys. Walkerdine's (1988) comments are particularly pertinent to this study because they refer to the time period (i.e. 1980s) covered by the QCA results for parents in Chapter 6.

In Chapter 1, I discussed how formal mathematics has moved towards more individualised methods of teaching and away from the collective learning favoured in Victorian times. Walkerdine (1988) suggests that this shift towards 'child-centred' learning gives undue prominence to the ideas of psychologists within education who move away from a focus on 'correct and incorrect answers' and towards one of characteristics of a 'normal learner'. It is within this context that discussions about the differences between male and female brains with respect to mathematics can be had and how theories suggesting innate differences between the sexes come to be accepted as scientifically-verified. In other words, parents with similar views to the parents of Sharron and Laura may be less-inclined to help a struggling female child because they may think she is unable to do the work whether they help or not. In the next section I show that, while attitudes such as this may no longer be prevalent among parents, different levels, types and forms of capital still help me to explain why the involvement of parents translates to high attainment in some cases rather than others.

<u>Parents (Generation 1) helping their children (Generation 2)</u>

In this sub-section, I focus on the help given by parents (Generation 1) in the study to their own children (Generation 2). The social-class positions for this section, therefore, are those correct at the time of the interview and not the historical, or origin, social-class positions. I divide this analysis into an examination of successful instances of involvement and unsuccessful instances and explore the types, forms and levels of capital possessed by parents to see if this can explain the outcome of the involvement. Learning from the analysis above, I also account for the children and their general ability, noting that, for some children, parental help may never be successful.

I then provide an analysis of some types of courses attended by parents with the view to raising their own levels of pedagogic or mathematical capital. I discuss, with examples, whether parents have found any of these courses useful for providing help to their children and suggest that each of these courses provides institutionalized capital for a slightly different field and, therefore, that not all of these courses will necessarily equip parents to help their children with primary school mathematics. Finally, I compare two different courses for parents run by primary schools and examine how the perception of usefulness of such courses changes for parents depending on the delivery method, location and format of the course.

Instances of parental involvement viewed as a success

Instances of intervention by parents tended to be considered a success by parents if the child claimed or appeared to understand whereas previously, they did not. I analyse here whether such instances can be considered a success within the field of primary school mathematics. Mathematical activities in the home considered to be successful tended to fall into two types of activity. The first of these is when parents seek to reinforce something that is being taught in school or to enhance understanding of a homework question by using practical examples and props to explain. Joanne, who has a daughter with some learning difficulties, explains that she was driven to seek a different way to explain because of the continual problems with written mathematics that her daughter was having.

It was a nightmare on paper. We weren't getting anywhere. We couldn't figure out take-away. She couldn't do it. We've got a money pot, pots, and we used pennies and we transferred the pennies to do the adding and I had cards with adding and taking away and that's helped. She can only do it by manually doing it.

Joanne, intermediate-class, Bankhill

In Joanne's case, she feels that an improvement has been made in her daughter's ability to perform subtraction calculations but notes that, despite this intervention, her daughter still struggles to write down calculations and needs props. As Joanne's daughter has learning difficulties, she receives specialised teaching at school and is allowed to complete sections of homework on a computer to help work around this problem with written calculations. I suggest that, particularly because of her daughter's additional difficulties with learning, Joanne does not have the levels of pedagogic capital (in either form) to be able to help her daughter. I discuss Joanne's additional strategies for helping her daughter in Chapter 8, where I analyse whether using her social capital to secure additional help is more successful.

Peter decided to use a watch to help his daughter learn to tell the time. For him, this was an easier way to explain the concept than to go through the homework sheet she had been given about it.

She had, she had the maths sheet there. It was, like, clock faces and times and she'd have a clock face that would say, '10 to 12' and then there was, like, two questions to it, 'If you take an hour and a half off this, what would the new time be?' So, she was writing off an analogue clock face and she was writing it in digital terms and it was trying to get the concept of, like, '10 to…', '5 to…'. I mean, we were sat there with a watch and I literally wound the clock round to whatever time it was and then, like, showed her how to work it out. I mean, she was okay, once she got the hang of it, she was okay, no problem with it.

Peter, intermediate-class, Rutherston

Setting and re-setting his watch to different times allowed his daughter to practice reading the clock-face and helped her to tell the time. Peter also suggested, elsewhere in his interview, that he found the topic to be so basic that he felt comfortable intervening and explaining it to his daughter. In this situation, I suggest that Peter reinforcing the methods used by the school to teach time but giving his daughter additional chances to practice. Kirsty, also used examples further re-enforce what her daughter was learning and felt that her daughter responded well to having additional, more everyday examples to underpin some concepts she had learnt at school.

Kirsty: And trying to bring it in, like I say, with everyday, trying to use an example of how you would use that particular problem in an everyday situation.

Interviewer: Do you think that helps her as well? Does she seem the type of person who likes having examples?

Kirsty: Definitely, definitely.

Kirsty, intermediate-class, Oscar Road

Neither Kirsty nor Joanne remembered feeling confident about mathematics at school and neither of them have attended any refresher courses or workshops organised by their respective schools and so their use of examples allows them to draw on the mathematical capital they do have to offer help, even if it is not institutionalized. In addition, neither of these mothers are teachers or have any teaching qualifications and so do not possess high levels of institutionalized pedagogic capital. Nevertheless, they are both able to provide assistance (however limited) to their respective children. Kirsty notes that her daughter rarely needs help and so it could be that her mathematical examples used in the home serve to reinforce the understanding her daughter already has rather than adding to it. For Joanne's daughter, standard teaching methods are not helping her daughter to learn mathematical concepts and so she devises different ways to communicate mathematical concepts to her in the home. I suggest then, that non-institutionalized mathematical and/or pedagogic capital can be useful for helping children who are not responding well to institutionalized teaching methods or for children who already have a strong grasp of mathematical ideas.

There were parents in my study who did have high levels of institutionalized pedagogic capital and variously used this to identify the nature of the problem their child was having rather than focussing on a particular question and, as I explore further in Chapter 8, to reach those with institutionalized mathematical capital. Karen, though she accessed institutionalized mathematical capital from work colleagues used her own pedagogic capital to transfer this to her son and chose to do that rather than get a work colleague to talk to her son directly.

They've explained it to me and I can pass it on. Because if I can't understand it, I can't, you know, show him.

Karen, intermediate-class, Bankhill

It is because, I argue, that she possesses pedagogic capital from her job as teaching assistant that she is able to do this rather than being forced to bring in outside help. She also identifies the best way to communicate information to her son based on her assessment of his learning style and her learning style.

And I do think, yeah, I think it's a learning style as well because I think, being a more visual learner and sometimes when you're more into English and that type of thing, you tend to be... So, I can draw it and I can see it rather than with numbers. That's the difference between me and him, you see. He's definitely auditory. And with spellings and things, he can just [points to head]. I have to write them down to check they're right.

Karen, intermediate-class, Bankhill

Karen suggests that these differences in learning style may lead to children, for example, approaching a calculation differently and her framing of this as a difference in styles rather than a correct or incorrect approach means that she does not challenge her son's method even when it is different from her own. Her work as a teaching assistant provides her with pedagogic capital which minimises conflicts about homework.

Sharron, instead, used her pedagogic capital to challenge her foster son's school when they sent him homework sheets with several different types of questions. She identified his problems with mathematics homework as being, not with individual questions but with the lack of focus on one theme in homework.

Yeah, I mean, I have worked with him on his maths homework because I did think, at one point, they were trying to push him too quickly. In which case, again, you'd end up with him not being able to transfer the skills. And requested that, when they send him homework, it is one thing. Because I was getting sheets that were, like, a times and then something on numbers with points and something on, you know, negatives. And there's no way that they were related enough for him to actually deal with it.

Sharron, intermediate-class, Churley Park

As a teacher herself, Sharron felt confident to approach the school with her request and framed it in language familiar to teachers. She recalled that her request was granted and attributes this to the teachers in her foster son's school knowing that she was a teacher and trusting her judgement about what the problem was.

It's really valuable because I can go in and say, you know, I don't really think he is this level yet. I think we need more work on it. And you, you've got the mutual respect. We're very close with the school anyway, you know, we go in, we know the people so it's not a problem, within your relationship, to question either. But obviously there's that mutual respect that we do, both [my partner] and I do know, you know, how it's working and how it fits together and what basics he needs to be able to move on to the next level.

Sharron, intermediate-class, Churley Park

She explains that the request to alter her foster son's homework sheets was granted and that this has improved his ability to do homework.

Interviewer: And when you requested that, were they quite happy to try and work round that with you?

Sharron: Yeah, I'm finding now that he's getting sheets with one thing on and, by the time I've gone through it with him a couple of times, he can actually do it independently. We were getting to the point where he'd just managed to grasp one thing and then we were on to something else, which threw him completely.

Sharron, intermediate-class, Churley Park

She specifically sees a great improvement in her foster son's ability to tackle homework questions independently and this, too, is indicative of her pedagogic capital because she sees prioritises him being able to independently tackle the questions over submitting a sheet of completely correct answers. Both Sharron and her partner use their pedagogic capital, then, to approach teachers in their foster son's school from a platform of a professional conversation and so feel listened to and are able to make changes to his individual programme of work. Here, then, even though neither Joyce nor her partner has institutionalized pedagogic, mathematical or linguistic capital within the field of primary schools, they have been able to help their foster son by liaising successfully with the school and using pedagogic capital to assess what is causing his difficulties.

Other parents, with more recently acquired pedagogic capital, found that this capital does not always mean that they can help their child. For Elaine, who had taken a teaching assistant course (for primary school), there were occasions where she found that her explanations were not helping her child.

Interviewer: Is it the sort of thing, that's it's more practical? You can look at it and think, 'I've been taught how to do this, I've recently done this, I know how to help'? Or is it just, you think, it's maybe improved your confidence in it?

Elaine: Both. The practicality of it and… He sometimes says he doesn't understand the way I'm explaining it, which is fair enough but I find this school tends to send home stuff that they've already been doing. They never send fresh work home that a parent's going to have to explain without any back-up. So, it's kind-of like, he should what he's doing when he comes home with his homework.

Elaine, intermediate-class, Oscar Road

Elaine talks about 'back-up' for the homework her child receives and I suggest that, by this, she means instructions from the school about how such a piece of homework should be completed.[43] So, even with her pedagogic capital, she feels more comfortable when

[43] I deduce this from the quoted excerpt and other sections in her interview.

there is an institutionalized explanation or method that she can refer her son to. In contrast, Paula's children (two of whom are now at secondary school), rely on their father for help with homework even though their mother, a teaching assistant, has high levels of pedagogic capital because their father, an engineer, is perceived by the whole family as very able in mathematics.

Yeah, I must say, he's the one that, if the children have got a query, particularly now they're at secondary school, the girls, they go to him because he's much better at maths than I am.

Paula, intermediate-class, Oscar Road

Paula does mention, elsewhere in her interview, that she and her husband offer different solutions to the children's homework problems but that she is happy for him to help because of his higher capability in mathematics or, as I suggest, his higher levels of mathematical capital. So, in her situation, she sees mathematical capital as more important, especially for her older children even though her own pedagogic capital is of the institutionalized form. Irene, also a teaching assistant, holds the opposite view and sees her institutionalized mathematical and pedagogic capital as making her the best person to help her child.

Yeah, I think also with me, obviously, with me working here, I know how the school would want her to do it therefore I wouldn't want anyone else teaching her how to do it the wrong way.

Irene, intermediate-class, Oscar Road

The cases of Paula and Irene may not, however, be directly comparable because while Paula's husband has high levels of mathematical capital, I cannot deduce, from her interview, whether Irene has such family members. It may be that Irene is the person in her family with the highest levels of capital and so, she appoints herself as the person her daughter should contact with homework queries. It could be, however, as implied by her mention of working in the school, that she sees her institutionalized pedagogic capital as more important than any other types and forms of capital that other family members possess.

As demonstrated above, the skills parents perceive they require to help may influence if they nominate themselves to help a child or, as I show in Chapter 8, who they choose to help instead of them. This process of determining who should help is, in itself, influenced by the levels, types and forms of capital that a parent possesses. One parent, Liz, described her own experiences of mathematics at school as positive and felt that she should be able to help her children with their homework in primary school. When she had a problem explaining a particular concept to her child, she *perceived* the problem to be linguistic in nature.

Liz: …the school did put on a parental maths session where we were told how it's taught now, so it has been easier the past few weeks, since that.

Interviewer: Ok, so that's really made a big difference then?

Liz: It has. Yeah, just the way you say things, for example, I was saying, 'When you times by 10, add a nought'. Apparently, that's not the way you do it now, you say, 'Move it to the left'.

Interviewer: Yeah?

Liz: And just saying those words has made a big difference.

[Later]

Liz: Yeah, I can see the sense in it but I just couldn't explain why she couldn't just grasp it when I was saying, 'Add a nought, it's easy'.

Liz, working-class, Glen View

As the above exchange shows, Liz seems to have a limited understanding of the concept of multiplication by 10. It could be, then, that Liz's understanding **and** the way she articulated it to her child was the problem. She perceives her own method and the vocabulary used to express it to be equally correct to the more modern version being taught to her daughter but, in fact, applying Liz's rule to decimals, for example, would give an incorrect answer. Though she has, in this instance, promoted a method that would not work in all situations, Liz does accept that older methods can be equally correct to new ones. I suggest that this is because of her confidence within mathematics and that other parents, who are less confident, may not accept that the method they can remember is equally valid to the one their child uses.

In some circumstances, rather than having problems with a whole topic, like above, a particular homework question can be confusing for parents. For Ruth and Peter, confusion arose with one of their daughter's homework questions about telling time. I showed earlier how Peter used props (in this case, a watch) to give his daughter examples to help her tell the time and how that this was successful. So, Ruth and Peter were confident that their daughter knew how to tell time properly but, when faced with a homework sheet on this topic, they struggled to understand how the school wanted her to answer.

Interviewer: And, has there ever been a time when she's brought something home that's caused you difficulty? You've felt confused by it?

Peter: Yeah, it was like, you had a clock face with, say, '10 to 10' on it and there was 2 questions. So, we answered the first question, but then we took the second answer from our first answer instead of taking it off the clock face

Ruth: So we don't know whether that was right, there was nothing to say which way round.

Ruth and Peter, intermediate-class, Rutherston

So, here, Ruth and Peter worry that their daughter's homework will be marked wrong and give the impression she cannot tell time properly because they recognise that, whilst there may be more than one answer to a vaguely- or badly-worded word-problem in primary school mathematics, there is one answer which is considered correct by the school.

Cooper and Dunne's (2000) work on real-life word problems in mathematics found that 'real-life' in mathematics problems often actually means a middle-class version of real-life and that, often, working-class children are disadvantaged in assessments that rely on word-problems. So, the question Ruth and Peter refer to *could* be a biased question. More likely in this situation, I suggest, is that the question was unclear and that Ruth and Peter were keen to help their daughter with it to avoid letting her teacher think she did not understand the broader concept. Situations like the above, when there are problems with homework, can cause friction between parents and children. In the next section, I analyse instances where parental intervention has been unsuccessful and show that high levels of capital are not enough to guarantee success.

Unsuccessful instances of parental involvement

For most parents in this study, if problems arose when parents tried to help their children, it was attributed to a lack of knowledge of modern methods or a lack of institutionalized pedagogic capital. Faced with this situation, some parents, like Ann and Laura, were reluctant to help in case the method they showed their child was wrong.

Yeah, because I mean, I know I can show my daughter how to do it one way and her dad can show it how he got taught. And it's different. You see, me now, when they try to do the work that they do here, you think, 'Well, how do you do this and how do you do that?' That's when, you know, I start to back down a bit, do you know what I mean? You see, some of the questions what she can ask you, you know, you're thinking, 'I could tell you something different to what your teachers would'.

Ann, working-class, Oscar Road

Because, it's like, what I've said to them before, you know, I can't help them if I don't know what you're working on. Because most of these children, as with any generation, parents don't know what the methods are. Especially since they have changed so much over the last 20 years.

Laura, intermediate-class, Rutherston

Ann talks elsewhere in her interview about wanting to avoid confusing her child and, from the excerpt above, we can see that she identifies her methods of explanation as being potentially different from her husband's and different again from that of the school. Ann is not confident with mathematics and recalls that she always struggled with the subject at school and this may explain why she thinks her methods are inferior to that of the school and chooses to defer to them. Laura is certain that her explanations would be different to that of the school and so chooses to seek information about their methods before attempting help. Ann's approach is in contrast to Liz, earlier, who accepted the school's methods of explanation after trying her own because she was confident her own approach was correct.

For Richard, a father who has returned to education to study university level mathematics and so could be said to possess high levels of, recently acquired, mathematical capital, word-problems are a constant source of problems for him and his daughter. Even for someone with a grasp of university level concepts, the lack of institutionalized pedagogic and linguistic capital appears to hinder his attempts to help his daughter.

And so there's a lot of, a lot of my time, when it comes to, and this is frustrating for [her], trying to put my view of what they're saying in the word problem to her in a way that I think she would understand. And, it turns out, it ends up being doubly wrong because she can't understand what I'm saying, she can't understand what the maths question is saying so we all end up chewing our fingernails.

Richard, intermediate-class, Rutherston

Another parent, Victoria, has resorted to doing her child’s homework for him because she feels as though he cannot understand her explanations. Unlike Sharron, in the previous section, who saw the aim of homework as producing an independent learner, Victoria is more concerned that the homework is completed and submitted to school, even if she has to do it.

I have to sit with [him]. It’s getting to the point with [him] where I’m having to do the work on a bit of paper and he has to copy it out. I’ve got to explain to him how I’m doing the sum, could be anything, right, and I’ve got to explain to him how I’m doing that or even if I’m taking, you know with block numbers, when you’re going behind, going, ‘9, 8, 7’ even stuff like that, I’ll have to explain loads of times to our [child] but sometimes I don’t think he’s taking it in. And then we’ll write the answers down and he’s got to write it on a separate piece of paper.

Victoria, working-class, Hunter Road

Where Sharron has used her pedagogic capital to encourage an alteration in homework to make her son more independent, Victoria, who has low levels of pedagogic capital, is keen that all her son’s work is completed and may be depriving him of a chance to come to the answers himself. For Ruth, being overbearing with homework was a worry and she admitted that she had been trying to give her daughter less help.

It’s a bit difficult though to get that balance. Sometimes, I’m a bit, I don’t know, I’m helping her a bit too much and not allowing her to work problems out on her own but, at the same time, I don’t want her to think that she’s left there to do it all on her own. She can ask and I try, not that I always know the answer, mind!

Ruth, intermediate-class, Rutherston

Ruth is another mother who feels that her own lack of pedagogic capital may cause problems when helping but her willingness to help does not seem to arise from mathematical confidence so much as not wanting to see her child struggle. She admits to being confused by some of the institutionalized language of the school and so, could be said to lack institutionalized linguistic capital. In addition, when discussing the material being covered with her husband, she admits that neither of them knows if their child is performing at the expected standard or not.

But we don't know. This is what is problem is, we don't know. We're not teachers so we don't know what is expected of what level. But if they're learning about it, I don't know, they're learning about it now so I don't really know what stage she should be at.

Ruth, intermediate-class, Rutherston

Both Ruth and her husband are keen to help their daughter and offer a supportive environment at home but, there are times, when they feel that their lack of institutionalized mathematical, pedagogic or linguistic capital prevents them from providing the correct answers to homework questions.

We've always let her, make sure that she can always ask. We might not always know the answer but we'll always try and help her or direct her in the right, and say, you know, 'I can't do this. You'll just have to take this back to your teacher and ask her to go through it with you'.

Ruth, intermediate-class, Rutherston

Unlike Victoria, Ruth and Peter would not do their daughter's homework for her and encourage her not to get upset if she gets answers wrong. For them, the process of homework allows their daughter to attempt questions and learn from any mistakes that she might make.

Peter: Yeah, we've done it how we think it should be done or we've told [her] how we think it should be done and if she's struggled…

Ruth: Said, 'If it's wrong, don't get upset about it'. Just say, 'Well, this is how we thought' and then we'll take it from there. I mean, you learn from your mistakes and move on.

Ruth and Peter, intermediate-class, Rutherston

For Mary, her son's homework is a chance for her to learn (or remember) the concepts that he is covering. I discuss Mary's main source of help, an older child, in Chapter 8 but, here, she explains that attending numeracy courses has allowed her to help her child more in certain areas rather than others. She sees her son as being a source of the institutionalized mathematical capital she needs to help him but does admit that, despite raising her own levels of mathematical capital by attending courses, she still feels confused by parts of his homework.

I have learned a lot more on fractions and your percentages but, at the same stage, when [he] brings his homework home and I don't understand, then he'll explain it to me and then I can pick it up quicker and I can learn it at the same time. Certain, just now and again, once in a blue moon, he'll bring something home and I don't know.

Mary, working-class, Oscar Road

Laura searches elsewhere for access to institutionalized capital and tries to interpret the information she finds for her daughters but admits that she finds the concepts difficult to understand and explain.

Like I say, if they come with any question and I don't know the answer, we go on the internet or I say, 'Right, well we'll go to the library or we'll find somebody who can'. But, with maths, it's a, it's, you know, there are lots of books, but to get it down to the age-level of a 6-year old is really quite hard. To, sort-of, put it in layman's terms for them, to really be at their level, you know, you can read any book to them and think, 'Well, I didn't understand that so how's a 6-year-old going to do that'.

Laura, intermediate-class, Rutherston

Laura does possess institutionalized pedagogic capital and I suggest that this is why she thinks the books or websites she finds need to be explained to her children. She can see that the language and descriptions are too difficult for young children and attempts to overcome that. I suggest that because her pedagogic capital does not relate to primary schools and because she admits to having low confidence in mathematics, she is unable to always interpret the information in a helpful way for her children.

In an attempt to obtain either pedagogic, linguistic or mathematical capital to overcome some of the difficulties that parents like Laura face, some parents attend courses or workshops to raise their levels of capital. Below, I summarise some of the types of courses taken by parents in this study and show how the courses chosen reflect a parent's own evaluation of their levels, types and forms of capital and the levels, types and forms required to help their child. For some parents, the desire to raise their levels of capital was rooted in self-improvement and these parents tended to attend courses offered by bodies other than their child's school. I investigate whether the rise in confidence that completing such a course can engender allows them to help more effectively and not the content of the course.

Courses attended by parents to raise levels of capital

Just over half of the interview sample had made some specific attempt to raise their mathematical capital by attending a course. Very broadly, these courses fell into 3 types:

1. Courses run by school personnel to explain teaching methods in mathematics
2. Courses run by outside agencies to provide qualifications in mathematics
3. Courses specifically related to teaching (e.g. CACHE Certificate in Supporting Teaching and Learning[44])

I suggest that courses of the type 2 may raise levels of institutionalized mathematical capital but that may not contain any instruction in teaching methods used in primary schools[45]. Type 3 courses may raise levels of institutionalized pedagogic capital but contain no specific mathematical elements. Type 1 courses, I suggest, provide institutionalized mathematical, pedagogic and linguistic capital and, although they may be

[44] http://www.cache.org.uk/cacheDNN/Portals/0/pdf/LBQ_2011_V2.pdf

[45] I say that these types of courses 'may not' contain to indicate that they may use methods familiar in some primary schools to communicate the material to parents but this is not guaranteed or a built-in feature of the course.

more specifically targeted to a particular schools methods and, therefore, not a recognised qualification, they should, in theory, give parents the institutionalized capital they need to help their children. Of course, as we have seen earlier, it is wise to remember that attributes of both the parent(s) and the child can affect how successful any help is and I, in the analysis to follow, try to explain the usefulness of a particular course with reference to the child and parent in question.

Reasons for raising capital

I have examined the interview data for instances of explanations by parents of their reasons for carrying out a particular course of action (such as taking a mathematics course). This type of examination of motive is different from trying to discern motivation in a more psychological sense. I agree with the conception of motive as defined by C Wright Mills (1940) that motives indicate an 'awareness of anticipated consequence' and through the interviews, I encouraged participants to imagine alternative realities where a different set of factors might have led to a different outcome.

In particular, many parents spoke of regret at their lack of (or lack of 'good') mathematics qualifications which they believed would have allowed them to achieve different successes in their lives. Returning to study mathematics (or the general teaching qualifications) was seen for some as a preliminary step towards a different career. For Mills (1940), 'stable vocabularies of motives link anticipated consequences and specific actions' which allows us to analyse why someone did something by asking them how they did it.

Of course, I must be aware that reasons given for an action constitute a social explanation on the part of the actor. By this I mean, we cannot know someone's reasons for action without that person explaining themselves to us and, therefore, making a social statement. In creating this social reason, the actor may feel compelled to adhere to social norms and give an account that is consistent with expected behaviour rather than one which accurately details their reasons for action.

Parents who aimed to raise their levels of mathematical capital

Some parents perceive their own lack of mathematical skills and knowledge (mathematical capital) to be the problem when it comes to helping with homework and make efforts to increase their levels of mathematical capital by attending courses which focus on teaching mathematical content. The most common course attended by those in this category is a Level 2 Adult Numeracy course. This is a free course offered to anyone who does not have a GCSE[46] in mathematics. Candidates are assessed with a short test before taking the course to determine whether they need to sit Level 1 first. There are two important things to note about this course. Firstly, it is advertised as equivalent to an A*-C GCSE because it sits at Level 2 on the National Curriculum Framework (NCF)[47]. Secondly, it is not universally considered as a GCSE pass by further and higher education establishments and is not considered equivalent to a Mathematics GCSE because it does not cover all the elements of the mathematics curriculum.

Those in my study who had taken this qualification (3 people) had either no qualification at all in mathematics or a low GCSE pass (grade D, in this case). One of the parents, Victoria, had been offered the course through the primary school that their children attend and it was held in the primary school building though delivered by a tutor external to the school staff. Others, like Elaine, went to a local college to find out if there were courses available in mathematics. For Elaine, a mother who has a grade D mathematics GCSE and has found mathematics to be a struggle in the past, the experience of learning mathematics again was satisfying as well as useful.

[46] Or an ‘up-to-date’ GCSE.
[47] http://www.direct.gov.uk/en/EducationAndLearning/QualificationsExplained/DG_10039017

What I did was, my little boy was struggling at school and I was just doing shop-work at the time and I chose to start volunteering here, loved it so much, did my Level 2, Level 3 CASH in Teaching and Learning and did a couple of maths courses. And re-sat my maths and English. And it was to help him initially but then I realised how much I loved it.

Elaine, intermediate-class, Oscar Road

Victoria also found the experience of learning mathematics again to be personally satisfying. She sat no exams at school and wanted to prove that she was capable of passing an exam and gaining a qualification and cited this as her main motivation for choosing to study again.

Victoria: I think it was the fact that I knew I could do it and I wasn't being able to do it at school, I wanted to prove I could do it, I think. I wanted to prove that at least I could get a certificate to say I'd done something, do you know what I mean?

Interviewer: Yeah.

Victoria: I've got a certificate to say that I've at least passed something.

Victoria, working-class, Hunter Road

For Ann, a mother with 7 CSE's but no mathematics qualification, the decision to take the mathematics course (and others that she's done) was directly related to wanting to help her child and something she felt others should also do. Ann's suggestion that all parents should attend similar courses reflects social pressure that parents may be under to take such courses. Her assumption that the course **will** improve her ability to help her child underpins her suggestion that all parents should embark on additional learning. It could be, then, that parents feel they should attend such courses and refuse to express that they were compelled to go for fear of being judged by other parents or the school.

Interviewer: And would you ever, you know, if there were more courses offered or if you really got interested in it, do you think you'd maybe look at doing another qualification?

Ann: Oh yeah! I would, yeah. Yeah, yeah, I would because all the courses they've had up here up to now, I've volunteered meself for doing them, do you know what I mean? You should, to help your child.

Ann, working-class, Oscar Road

Elaine, like Ann, also cited helping her child as the main motivation for taking the mathematics course but Victoria was primarily interested in the status of the qualification and what it represented to others about her capabilities (although she agreed that it had helped her to help with homework). In this way, I argue that Victoria was concerned with obtaining mathematical capital only but Elaine and Ann were obtaining capital with the intention to transmit it to their children. For Victoria, the qualification was most important and, for the other two, the chance to help their children was. In the case of Victoria, the social dimension to the qualification, captured by her desire to 'prove' her capability, shows that, for her, the qualification is a status symbol (where I mean, the Weberian concept of status as a social evaluation of worth).

Richard took an entirely different qualification from the other 3 parents mentioned above. He had returned to learning as a mature university student to study undergraduate mathematics. He already possessed a science degree, masters degree and nursing qualification. His reasons for returning to study mathematics were related to intellectual curiosity and not explicitly for the purpose of helping his child nor gaining status.

I've been taking… maths again at the Open University and I really enjoy that. I'm quite obsessed with it. And I think it starts to go back to me wanting to explore those ideas I had as a child to explore the larger concepts of those things like your physics and so on, the more complicated aspects of everyday life.

Richard, intermediate-class, Rutherston

A common feature of all those who sought to raise their mathematical capital is that they had experienced some difficulty with mathematics in the past. Ann and Victoria had no formal qualification in mathematics whilst both Elaine and Mary spoke of attaining a poor grade in mathematics exams. For Elaine, this was indicative of a general struggle with the subject at school.

I struggled with maths, all the way through primary and secondary education. I found it a real challenge. I… My memory's quite poor and I would forget basic things and get quite stressed out by problems, you know, like word problems. I would find them quite stressful. And I, I asked to do a lower GCSE paper. I found my maths teacher in secondary school quite chauvinistic, almost, kind-of. If the girls were struggling, they seemed to get left but the boys, the boys were good at maths and the girls weren't. I felt it was a bit like that. And I did struggle. I only got a D in my maths GCSE, D.

Elaine, intermediate-class, Oscar Road

This extract shows Elaine trying to explain the root of her difficulties which she attributes to her own poor memory and, later, an unhelpful teacher. She also indicates that she found struggling with mathematics to be stress-inducing which indicates a desire to do well in the subject. Mary, however, felt differently about mathematics at school and explained that she thought her exam result was not indicative of her ability. She also remembered enjoying the subject, unlike Elaine.

Maths, when I was at comprehensive school, out of 90 children, I was 2nd... I really loved me maths...To be honest, when it came to my grades, I did badly.

Mary, working-class, Oscar Road

Whilst we can ascertain from her statements a genuine enjoyment of mathematics, it is harder to discern whether her exam was, in fact, a true reflection of ability or not. She makes a judgement about her ability in a relative way by comparing herself to other classmates but, without extra information about those classmates and their abilities, it is impossible to judge the general standard of mathematics in that school. Mary could, then, be an example of someone with more institutionalized mathematical capital than her qualification suggests. As I noted in Chapter 3, my model of capitals allows for qualifications to be a measure of institutionalized mathematical capital but not the only measure. Later in her interview, however, Mary seems to hint that taking the exams themselves was the problem and that she did not do as well as she might have because the exams went badly.

I must admit, since, I mean, yes, when I got my GSCE's and a couple of years later thinking, 'God, I wish I could turn the clock back and re-do all me GCSE's' but now, looking at things, and the position that I'm at now and refreshing meself over the years, I've done better since leaving school and everything, meself, now.

Mary, working-class, Oscar Road

Mary's focus on her achievements outside of school suggests that she may not value institutionalized capital very highly and that she does not think her qualifications reflect her capabilities. She does, elsewhere however, mention that she has taken the opportunity to do courses with work and through her older child's secondary school. Perhaps, then, Mary is similar to Victoria in that she is trying to prove, via qualifications, that she is capable of doing well in mathematics.

Richard's struggle with mathematics came at a higher level, when he was at university studying biology. Suzanne, his wife, talked about how he now has more knowledge of mathematics than she does when, previously, it was the other way around.

We did the same course, that's where we met, at [university]. The maths there, because I understood it and [he] didn't, and we were, kind-of, going out together, I helped him quite a lot with it really. I'm not being big-headed because I am not that good at maths! Now, you're really, really good and some of the maths he does, I think, 'Goodness, what's that?'

Suzanne, intermediate-class, Rutherston

Though the struggle, for Richard, occurred at a higher level of mathematics than for Elaine or Mary, there is still evidence from his interview of a period of struggle with the subject and a desire to re-visit it through formal learning. Richard suggests that his increased maturity now allows him to understand more difficult mathematical concepts. He talks about the abstractness being a barrier to his understanding when he was younger but not in his more recent study of mathematics.

And I think, for me, that was, sort-of, went adrift when it came to the mathematics, because I couldn't, I could no longer see the same sort of window into the world that I did for the physics side of things or the biology. It was a little bit too abstract for me. Yeah, and even though it's abstract now, I think it's the maturity side of things that's driving me forward.

Richard, intermediate-class, Rutherston

So, as we can see, there are similarities in the past experiences of mathematics for those parents who chose mathematical courses to pursue as adults. All of them experienced a period of difficulty with mathematics when at school, though this occurred at different stages of difficulty for different parents. I now examine those parents who took courses to raise pedagogic capital recently, to distinguish them from those in the study who were teachers or teaching assistants and had older qualifications.

Parents who aimed to raise their levels of pedagogic capital

Three of the parents I interviewed had done a teaching assistant course in the last 5 years. In two cases, those parents had also taken a mathematics course. In this section, I examine the three cases where a parent recently qualified as a teaching assistant to see if these parents are differently able to help their children. In particular, with reference to the case of Rachael, I examine whether institutionalized pedagogic capital alone is sufficient for helping a struggling primary-school child or whether a certain level of mathematical capital is also needed.

The two parents who had a teaching assistant qualification and had taken a mathematics course were Elaine and Mary. We have seen earlier that they were both disappointed with their performance in GCSE mathematics which may, in part explain their reasons for taking mathematics courses later in life. For Elaine, returning to college to study both the mathematics courses and the teaching courses was done with her son in mind but also to improve her own job prospects.

Interviewer: Did you stay on at school after that, though?

Elaine: No, no. For some bizarre reason, I got offered a job from a Saturday placement and I took it. I should've stayed on at school but I didn't.

Interviewer: Is it the sort of thing that you regret now, that you didn't stick around at school?

Elaine: Well, I've changed it around now because I've gone back to college. I think I probably would've ended up doing a bit more with my life instead of just shop-work.

Interviewer: When you went back to college, is that to help you with the job you're doing now?

Elaine: I'm actually only... I've been on supply at the school but I'm only volunteering at the moment. I'm open to supply [work].

Elaine, intermediate-class, Oscar Road

She had volunteered at the school before taking the courses which raised her levels of pedagogic capital but what is unclear (from this extract and the one earlier) is whether she imagined all the courses (the mathematics ones and the teaching ones) would allow her to help her son or whether she saw them, as I have in this chapter, as falling into two types of course: those to do with mathematics (which would address the problems her son was having) and those to do with teaching (which would help her to change jobs). Later evidence from the interview of Elaine suggests that she was as concerned with accumulating additional mathematical and teaching capital as she was with making useful connections within the school. In Chapter 8, I discuss more fully, with reference to Elaine's case, whether those with social networks which include teachers can bypass the need for a certain level of mathematical capital. What we can see from Elaine, however, is that she saw the need to improve her level of mathematical capital in addition to the other strategies she employed.

Mary, similarly, saw fit to attend mathematics courses in addition to teaching ones. For her, the decision to take teaching courses stemmed directly from a desire to work in a school and work with children.

And then I went on to do me teaching assistant course and I'd love to get a teaching assistant's job but, sort-of, at the time there was none available and I, sort-of, went back into care knowing that I would get a job, no problem. And I'm still there... See, I didn't want to become a teacher or a teaching assistant at that age [school leaving age], I just wanted to work in a care home and that was it. And, it's, as I've got older, worked with, like, looked after me own children, sick of being in the house being bored, that's why I took a crèche course, really enjoyed it, spending time in a school and thought, 'Right, I'm going to do me teaching assistant's course'.

Mary, working-class, Oscar Road

For her, the teaching courses were job-related but the mathematics courses, I cannot be so certain about. One of these was taken at a local secondary school and was offered to her because she also has an older child but the second mathematics course she took was arranged through work. It could be, then, that Mary has taken all opportunities available to her to raise her levels of mathematical capital because, as we saw earlier, she was disappointed with her GSCE performance.

A further difference between Elaine and Mary is the previous mathematics attainment of their respective children. While Elaine articulates that her child was behind the rest of his class, Mary has no such worries about her child. Teacher judgements about Mary's boy suggested that he was working at a slightly above-average standard compared to classmates. It could be that Elaine's motivation lay more directly in helping her child because there was a problem with attainment that she wanted to address whereas Mary did not see that there was a problem to be tackled, in her case.

Rachael, who did not take an additional mathematics course, was primarily concerned with bettering her employment prospects because she worried about the social perception of her current job. In particular, she spoke of wanting her children to be able to tell others that she had a different job.

I just work in a factory now. I mean, the money's good and I can come and go as I please, basically, but it's not a career. And I would like for me children to say, 'Oh, me mam's a…' instead of, 'My mam works in a factory'.

Rachael, working-class, Oscar Road

Here, Rachael makes the distinction between a job and a career and sees having a career as preferable to having a job. It is clear that she is concerned about the perceptions of others because she mentions some positive aspects to her current job and is keen to emphasise that she is not being financially disadvantaged by working there. Her decision to take a teaching assistant course, then, is routed in a desire to increase her levels of pedagogic capital to secure a job with a higher social status and not directly to help her child. Despite this not being the primary aim, Rachael does mention that her course has been helpful for acquainting her with newer teaching methods and suggests that she is finding her newly-acquired institutionalized pedagogic capital helpful for helping her children.

With doing this course that I'm doing now, obviously, I'm picking up a lot more things. And just the way they teach as well.

Rachael, working-class, Oscar Road

I would have liked to interview more people like Rachael who have increased their levels of institutionalized pedagogic capital but not their levels of mathematical capital to explore whether, for some parents, increased institutionalized pedagogic capital is sufficient to help their children. We could imagine that, for parents like Liz, mentioned earlier, who have high levels of mathematical confidence or for parents like Richard, who has very high levels of institutionalized mathematical capital, that an increase in institutionalized pedagogic capital would help them to help their children. For other parents, however, their levels of mathematical capital may be too low for increased institutionalized pedagogic capital to make a difference to helping their children with mathematics. Below, I discuss the courses run by schools which offer parents a chance to gain institutionalized pedagogic, mathematical and linguistic capital.

Courses run by schools

The courses run by schools (type 1) were attended by 40% of those who had attended any course. Unlike courses offering specific qualifications, courses of type 1 have no standard framework and can vary a great deal from school to school. I observed two such courses which operated very differently. Implicitly, both these courses required a basic standard of mathematical competency and were marketed to parents as an opportunity to understand modern teaching methods, and thus as a chance to raise their institutionalized pedagogic capital, but not as courses to improve their own proficiency in mathematics. I suggest, however, that they do offer a chance for parents to increase their levels of institutionalized mathematical, pedagogic and linguistic capital because they cover a very narrow section of primary mathematics (i.e. the methods and content covered by the school and terms used to explain this[48]). The courses were run, in both cases by teachers, held in their respective schools and were one-off sessions. I also note here that schools are under no obligation to offer such a session and, in this study, of the six different primary schools, four offered such a session.

Differences in workshop structure and timing

At Rutherston Primary, I talked to three families about their experiences of the school workshop. This school ran a session in a normal school day and parents were invited to attend a mathematics lesson in their child's classroom. When confirming attendance, the parents had been asked to specify which areas of mathematics were causing problems at home. The lesson was then based around this topic and parents sat with their children; working through a problem with them whenever group work was done.

This structure created a subordinate role for parents and privileged the institutionalized version of methods and language used. As the parents were in the class with their children, the teacher was the dominant authority figure and this reminded one parent of their own experiences of school:

I think, it took me right back to school, it really did, I would say. It was quite intense, I felt.

Suzanne, intermediate-class, Rutherston

The physical location of school, which for some parents was the same school they attended, could trigger memories of parents' own school experience but, further, to hold the workshop in the classroom requires the parents to sit next to other children and, in one instance, stand up in front of other children and present an answer to the class. One parent

[48] I realise that, more broadly, the content of school mathematics is determined by the National Curriculum but I argue that methods used to teach specific areas and some linguistic terms can vary from school to school (as it did in this study).

who did not attend (but whose husband did) explained that she thought that format may discourage parents from attending:

Ruth: But, I think, at the same time, a lot of parents might be put off, you know, depending on their ability, you know. I mean, you said you were all stood in front of the class at some point…

Peter: Oh yeah.

Ruth: And some people might find that intimidating. It might not be their cup of tea.

Ruth and Peter, intermediate-class, Rutherston

This workshop was held in the daytime which could also be seen as a barrier. For people who are not able to determine their own working hours, a one-off workshop, during traditional working hours may be impossible to attend. For Ruth and Peter, a two-parent household, Peter attended the workshop even though, in their family, Ruth tends to be the parent who helps most with homework.

Peter: At the same time, I think we were lucky in that the way me shift rota works. I was actually able to take the time off because a lot of parents are working all the time.

Ruth: You see, I was already at work and with me being at work, that's why we decided [he] would come.

Ruth and Peter, intermediate-class, Rutherston

It could be, then, that the format and timing of any such workshop could have an effect on who attends and, for some families, not sending a representative could be as a result of a practical difficulty rather than lack of interest. When I raised this issue with teachers, one teacher suggested that any time suggested for a workshop of this sort would lead some parents to complain that they could not attend. Another teacher said that her school had stopped providing photocopied booklets for parents and created a web-based resource instead because the photocopying was expensive and there was no clear way to tell if any families actually used it.

In Glen View Primary, the mathematics workshop was conducted differently. Parents were invited to attend immediately at the end of the school day. Despite what may appear a more favourable time, around the same number of participants attended (from a similar sample size of potential attendees as at Rutherston). They sat round a large table in a room designed for use on in-service days and not in an actual classroom with their children. The class teachers for Year 5 and 6 jointly gave a powerpoint presentation detailing the methods used in that school to teach areas such as division. At the end of the presentation, parents were given an example SATS question to try individually. The two class teachers interjected when asked to and gave individual assistance.

So, the two workshops I observed differed greatly in timing, location, format and opportunities for parental input. While one was held in multiple classrooms during the school day with the children present, the other was after school in a separate room for parents only. The former was conducted as a normal lesson with parents acting in the same capacity as children during this lesson while the latter was a specific powerpoint-based workshop aimed at adults. I argue that interactions between parents and teachers were shaped by these differences in format and location and, for example, treating parents as children could make them feel uncomfortable. Laura, who attended the workshop that was conducted in class, explained that she would have preferred a different format.

Interviewer: Do you think things like the parents' maths meeting that happened, do you think those sorts of events are useful to try and bridge that gap between parents and…

Laura: Yes, definitely, definitely. But I think there should be a parental one only. Where a teacher actually sits with them and does a proper class, with the parents, to explain, 'This is our method'.

Laura, intermediate-class, Rutherston

There was no evidence from either of the schools whose workshops I observed that parents had been involved in the process of deciding when to hold the workshop and what format it should take. At Rutherston, teachers did ask parents to suggest a particular area that their child was finding difficult so that the lesson could be geared around this. As there was a relatively low attendance at this workshop (less than 10 parents) and because all the parents selected the same area to focus on, this was managed fairly easily by the school. We could, however, foresee a situation where several different areas of difficultly are offered by parents with children in the same class. Teachers may find incorporating several elements into one lesson makes that lesson disjointed and parents could complain that unequal amounts of time are being spent on each area. Border and Merttens (1993), who were involved with the IMPACT project, suggest that the format of a parent meeting can lead to some parents' views being neglected and other parents taking over.

In fact, while involving parents in the decision process about workshop content and structure may seem to address some of the power inequities, it is open to manipulation by parents who have greater levels of educational confidence (a type of diffuse cultural capital) and pedagogic capital. Further, there must be some shared understanding of what can be achieved in such a workshop and what level of background knowledge is required. As Bourdieu (1974) notes:

> "An educational system which puts into practice an implicit pedagogic action, requiring initial familiarity with the dominant culture, and which proceeds by imperceptible familiarization, offers information and training which can be received and acquired only by subjects endowed with the system of predispositions that is the condition for the success of the transmission and of the inculcation of the culture".

In the above quotation, 'the dominant culture' could mean many different things. It could refer to the culture and practices of the majority ethnic group – an area covered by Gill Crozier in her work on the sociology of race. She suggests that parents who are of a different social class and race to their child's teacher struggle to engage with school outreach activities in the same way as parents with more similar backgrounds to the teachers in school (Crozier, 1999). While the difference in race is more obvious, her interviews suggest that differences in levels of cultural capital may be at the heart of the problem. As Bourdieu (1974) suggests above, those with low levels of a particular kind of capital may find it difficult to acquire or transmit cultural capital in an educational setting if they do not also have a set of predispositions, associated with the dominant culture, bound up with that capital. In the specific example of parent workshops, parents with particularly low or high levels of mathematical capital may find them too hard to understand or too easy, respectively. Some parents may then struggle to communicate what they have learned to their children. So long as there are differences in the levels of capital of the parents attending a workshop, it will provide varying degrees of help. So, taking the constructivist approach and viewing learning as a dialogue between parent, teacher and child may sound like a plausible solution but the practicalities of such an approach may prove difficult as those parents with high levels of, for examples, diffuse cultural capital may take over the process and shape it to benefit themselves and not the majority.

Differences in workshop content and teaching methods

The first striking thing, for me, was that Rutherston had some different teaching methods from Oscar Road; in particular, the method for teaching long division. This lends support to, what Ernest (1991) terms, a relativist perception of mathematics education. A relativist perception sits between the ideas of dualism and plurality by acknowledging that there are useful criteria which can help us to rule out some approaches as incorrect whilst still accepting that there may be more than one correct approach.

Several parents in the study, when expressing confusion at modern teaching methods, refer to such methods as **the** way in which is subject is taught now. This implies that they accept the notion that there can be multiple ways to teach a certain topic but that which way is used is an indicator of the time rather than perceiving that multiple methods could be in use at any point in time. The use of the definite article, in the excerpt below, to refer to a method indicates its position as a preferred or favoured method.

Interviewer: Did you, when you heard that they were doing a maths workshop, to, kind-of, explain these methods and what they were doing, is that something you felt you really had to be at?

Liz: Yeah, yeah. Just to find out exactly what is the method of teaching now.

Liz, working-class, Glen View

Whilst these courses can aid communication between child and parent when homework is done, they serve to reinforce the position of power occupied by the school by privileging the method of the school. The 'new methods' being disseminated to parents are described in the context of an advancement in educational practice and represent a break from traditional methods. In this sense, much non-institutionalized mathematical capital (or older forms of institutionalized mathematical capital) that parents have, needs to be combined with the institutionalized mathematical, pedagogic and linguistic capital that is being disseminated though schools.

Liz suggests that parents need to be willing to accept, for example, these newer methods if they are to be able to help their child. For her, a lack of acceptance of changes in teaching could lead to a parent missing out on a way to communicate mathematics to their child more effectively.

It doesn't matter who you are, as soon as you see, 'This is the method that's used now', whether you're open-minded or not, you'll think, 'Well, I wasn't taught like that'. And you will think, 'I turned out fine. Why change?' But, obviously, things progress and there will be better methods. There's always going to be a better method for something. You're never going to get the perfect system, so why not try new methods? See if it does help more?

Liz, working-class, Glen View

Summary

In this chapter, I have discussed how the parents of those in my study helped them with mathematics as children and how the type of help they were able to give is largely determined by their levels of cultural capital. I also offered explanations of why some of the QCA results in Chapter 6 appear as they do by including by discussing why some children can attain highly in mathematics without parental involvement, why parents in the 1980's may not have been so keen to support girls' learning of mathematics and why different parents were differently able to help. These explanations, based on a small sub-sample, offer potential causes for the results shown in Chapter 6 and do not form an exhaustive list but, nevertheless, I do think that they are useful to help us understand why some of the results from Chapter 6 may have occurred.

I then focussed on the help given by parents in the study to their children. I examined the cases in which institutionalized capital (within the field of primary school mathematics) was not always required to provide successful help. I also discussed how parents' views on whether help had been successful was influenced by their levels of cultural capital and, with reference to the case of Liz, showed how parents can perceive they have the necessary cultural capital to help but, in fact, do not. For parents who admit that help has not been successful, their levels of capital may not always be the cause. I suggest that some children who have particular difficulties may not benefit from parental help and that those parents with high levels of cultural capital may not always be able to help successfully. Underpinning this analysis is the idea that institutionalized forms of cultural capital (where the field is primary school mathematics) are most useful for helping children with primary school mathematics but that, one type such as mathematical capital, alone may not be sufficient.

I show that, though class is a summarising variable for levels of capital, by picking apart the types, forms and levels present in parent, I can offer explanations as to why some parents, for example from the working-class, may be able to offer help when others cannot.

Parents, I suggest, have a loose understanding of capitals because many of them see their own skills and/or knowledge as being insufficient to help their children and attend courses or workshops to attempt to remedy this. I explore whether raising mathematical capital alone is sufficient or whether this needs to be of the institutionalized form specifically and combined with institutionalized pedagogic capital in order to allow parents to help their children successfully. Some courses, such as those run by schools, allow parents to gain institutionalized mathematical, linguistic and pedagogic capital simultaneously.

Finally, I compared two different courses run by schools and discuss whether the specific focus on institutionalized cultural capital created an uncomfortable atmosphere for parents and whether this in turn, could lead to them not wanting to attend a course which is potentially the most useful course for helping their children with primary school mathematics.

We see, in this chapter, why there are differences between parents of different social classes.

In the next chapter, I analyse how parents use their social capital to secure access to individuals outside of the family unit and how the parents' own levels of cultural capital determines who will be chosen and how successful the help is. I also argue that older children constitute an important source of social capital for parents and that they can be used as an additional source of help in the home. Finally, I discuss whether those with access to institutionalized pedagogic capital can secure successful help for their children even if their own levels of cultural capital are low.

Chapter 8 – Parents and Social Capital

In this section, I discuss the use of social capital by parents to help children with mathematics. I begin by offering a definition of what social capital could mean in an educational setting by discussing the work of, particularly, Bourdieu and Coleman but also some other prominent sociologists. I consider that, for my study, while social class and social capital may be correlated for some individuals, analysing social class alone cannot tell us who individuals have in their social networks. I offer an account of what social capital is and how I conceive of it here before, as in Chapter 7, analysing the use of social capital by the parents in the study. I choose to focus on them (rather than their parents) to help me answer the questions posed at the beginning of Chapter 7, namely:

- Who do parents choose to provide help?
- How is this person selected to help?

These questions should help me to see what criteria parents use when selecting someone to help and how these criteria are shaped by parents' levels of cultural capital. I see social capital as a way, for parents, of accessing cultural capital that they do not possess themselves. Firstly, I examine one case where parents (Generation 1) have accessed someone who works directly with the child. In this case, I argue, parents' own levels of capital are important for the purposes of deciding who to approach for help but, since the capital is being transferred directly from this person to the child, the parents' levels of capital do not facilitate or hinder the transfer of the capital.

Secondly, I examine cases where parents (Generation 1) have used their social capital to access additional cultural capital which they then transfer to their child. In this situation, I suggest, the parents' levels of capital determine not only who is selected but also how successful the transfer of capital is. Parents with, for example, low levels of pedagogic capital may not be able to transfer their newly acquired cultural capital successfully. I consider, here, older children to be part of a parent's social network and explore whether, because of their links to institutionalized capital, older children are a particularly valuable social link.

When examining cultural capital in Chapter 7, I saw different types of capital acquisition and deployment from different types of parents. I argued there that courses designed to improve mathematics knowledge and skills may not be as useful as courses covering specific teaching methods for parents who want to help their primary children with mathematics. A similar distinction exists when selecting someone to help on your behalf. A parent may assume that someone with a high level of mathematical capital would be the ideal person to help but, as we've seen with parents who help their children directly, a high level of mathematical capital is not always enough. Parents will make some judgement when selecting someone to help and what I seek to explore in this section is why a particular person was chosen. Just as not every school will run a course, not everyone will have access to those with high levels of mathematical capital. It is possible, of course, to circumvent this by purchasing help (a form of transferring economic capital to cultural capital) through a tutor but not all parents will be in a financial position to do this, even if it is a preferred course of action.

Finally, I examine a specific case where a mother deliberately acquires and then uses her social capital to bring about a change in how her child is treated at school. This situation is different to the others mentioned as they concern interactions in the home or, at least, outside of school. I suggest that this mother is able to change how her child is treated at school because of her social and cultural capital levels and argue that her high levels of pedagogic capital, in particular, make her interactions with teachers like professional conversations, as with Sharron in Chapter 7.

In the study, there were 7 parents who had already sought help for their child in mathematics from their social networks. Other parents, even if they had not already, were open to the idea of using social networks to help their children. One parent had enlisted help from friends for problems with other subjects but not mathematics, one had received help from relatives without specifically asking for it herself and one said she would consider asking for help from relatives but had not so far. Of those 7 parents who had sought out help, 3 had gone to relatives and 3 had asked work colleagues. One parent sought help from a teacher she knew who had been her child's learning support worker. This person was the only individual who was paid to give help. I separate this from simply getting a tutor as the individual was located and selected through personal networks.

Definition of social capital and its use in education

Coleman's conception of social capital

Coleman's (1988) conception of social capital aims to bridge what he sees as two competing theoretical positions about 'social action' in sociology. The first of these conceives of a social actor as responding to social pressures, such as obligations or social norms, and the second, derived from the rational-action tradition, sees the social actor as individualised and striving for their own goals. As Coleman (1988) suggests, there are weaknesses with both these conceptions of social action. Where an actor is merely responding to social situations, he or she has no, what Coleman (1988) terms, 'engine of action' or no internal reasons for pursuing a particular course of action. Conversely, to assume that a person never reacts to society when making decisions seems to completely contradict what we observe in the world.

Instead of subscribing to either an extreme idea of the socialised nature of man or a completely rational-action perspective, Coleman (1988) develops a theory of social capital which places social capital as just one kind of many resources available to a rational actor. He decomposes social capital into types of relations, arguing that each constitutes a slightly different form of relationship between people. The first of these, obligation and expectation, describes a relationship with an obvious analogue to economic capital. One person (A) performs a favour for another (B) which, in turn, creates an obligation for B to return the favour at a later date and an expectation for A that this will happen. Coleman (1988) notes that, in many social situations, there will be many obligations outstanding and that not all obligations are considered equal. The key to a system like this operating is trustworthiness and so, Coleman (1988) suggests, it is most commonly found in closed social groups. A closed social group, as I conceive it, is one which it is not possible to join without a connection to a current member and one in which relationships primarily take place within the group. Common examples are groups whose members have family or religious ties. Since Coleman (1988) focuses on the nature of the relationship between people as the crux of social capital, it is still necessary, within this framework, to add a separate dimension for indicating which members of a group may be most powerful. As Coleman (1988) explains, even within a framework of obligation and expectation, not all obligations are equal and some members of a group may be more able to reap the benefits of their capital than others.

Coleman's (1988) second type of social capital relation focuses on the flow of information between people. Unlike a system of obligation and expectation, this does not require a closed system to operate effectively because it merely categorises when a person has used social contacts to obtain information which they may then use to inform a course of action. Coleman (1988) suggests that the social relationship between actors engaged in information sharing is not one of creating obligations but I would argue that this is not always the case. We could imagine a situation, in the educational context, where a parent circulated information about an unprofessional teacher with the expectation that those given the information would complain en masse so that the teacher would be dismissed. Coleman (1988) also downplays the role that trust plays in this relation by claiming that the information itself is the valuable part of the relationship. I would argue, however, that the trustworthiness of the source of that information is key for making a judgement about the quality of the information. By this, I do not expect that most deliverers of information are trying to be deceitful but merely that they may think the information they are offering is true and/or helpful when it is not. I suggest that the presence of institutionalized pedagogic, mathematical or linguistic capital in an individual can make them seem trustworthy to deliver information about concerns with schooling. To illustrate, I take an example from the context of the 'Math Wars' in the USA. The Math Wars are debates among teachers and between teachers and parents about the best way to teach secondary school mathematics in the USA. One group of parents (and teachers) staunchly defends traditional teaching methods, like rote learning and individual exercises, and, when schools attempt to reform teaching methods in favour of, for example, increased group work, these parents circulate (false) information about the new methods and tell other parents that this form of mathematics is not as highly considered for college admission.[49] This, then, is an example of when the information gathered must be coupled with some notion of trustworthiness.

Coleman's (1988) third type categorises social norms and the 'sanctions' that can apply for not following those norms. For a norm to be effective at regulating behaviour, it must have some sort of sanction, a negative consequence, for not following it. In effect, Coleman (1988) argues, an effective social norm reduces deviant behaviour. Whilst this may have a positive consequence in some cases it also rules out deviant behaviour that may benefit the wider community in which the norm applies. Coleman (1988) suggests that this is another type of capital that requires a closed community in order to operate effectively. Norms, he argues, cannot be reinforced without a sense of social shame (my term) which, in turn, requires a high degree of interlinkedness between group members.

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[49] For more on the Math Wars, see Apple (2002) and Boaler (2008)

The idea of closure is not the only way that Coleman (1988) links social capital to the social structure. He also draws on Gluckman's (1967) idea of 'single' and 'multiplex' relations to theorise social organisation. By doing this, he aims to account for those people who have multiple social linkages by assuming that they may use either information or an obligation relationship from one context and transfer it to another. For Coleman (1988), there is sustained focus on the nature of social groups and its effect on what types of capital may operate within them but less discussion of the role that various forms of capital (but particularly social and cultural) play in maintaining or reproducing social structures. Schools in the UK are a good example of a social structure which imposes social norms upon its members (including children, parents and staff) but, in turn, attracts members to it who have similar norms.

The problem I encounter, when trying to use Coleman's (1988) ideas of social capital from my analyses is the relative lack of attention paid to the transfer of one form of capital to another and from one person to another. Testing empirically for indicators of social capital and modelling these against indicators of, for example, financial capital or family size, as Coleman (1988) does, assumes that the *very presence* of social capital is enough to produce an effect on, for example, whether a child drops out of school. I argue, instead, that attempting to understand the *deployment* of capital is crucial to understanding why a particular outcome occurs or does not occur. Within a framework of rational action, social capital becomes one of many resources which *can* facilitate action. I argue here, and at various points in the thesis, that in order for social (and cultural) capital to produce a discernable change in a situation we must analyse the transference of capital through an examination of how it is accumulated and deployed.

Bourdieu's conceptions of social capital

For the reasons discussed above, I find Bourdieu's (1986) ideas about social capital to be far more useful in my context because of his specific focus on the transmission of capital and its role in the maintenance of social structure. For Bourdieu (1986), capital is 'accumulated labour' which a person gathers, over time, to give them 'the potential capacity to produce profits'. This idea of producing profit is at the heart of Bourdieu's (1986) conception of capital and derives from the Marxist conception of capital. Capital, he contends, is the reason that, in social actions, not all outcomes are equally possible for all individuals.

For Bourdieu (1986),

"Social capital is the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in other words, to membership in a group".

The key difference from Coleman's (1988) perspective is that Bourdieu (1986) treats social capital (and other forms of capital, for that) as an 'actual or potential resource'. Working within a rational-action framework, Coleman (1988) collapses the idea of 'actual or potential resource' into actual resource suggesting that a social actor does draw on every resource available to them when carrying out a social action.

For Bourdieu (1986), all forms of capital, ultimately, can be traced to economic capital but are not directly reducible to it.

"So it has to be posited simultaneously that economic capital is at the root of all the other types of capital and that these transformed, disguised forms of economic capital, never entirely reducible to that definition, produce their most specific effects only to the extent that they conceal (not least from their possessors) the fact that economic capital is at their root, in other words – but only in the last analysis – at the root of their effects." (Bourdieu, 1986).

That's to say, by looking backwards in time, so to speak, we may be able to find an economic root for, say, a person's social capital but the key to how useful this capital is lies in the individual's deployment of it. These other, 'disguised forms' of economic capital require an investment on the part of the social actor to develop and sustain. As Bourdieu (1986) explains:

"This work, which implies expenditure of time and energy and so, directly or indirectly, of economic capital, is not profitable or even conceivable unless one invests in it a specific competence (knowledge of genealogical relationships and of real connections and skill at using them, etc.) and an acquired disposition to acquire and maintain this competence, which are themselves integral parts of this capital".

He suggests that, unlike money, symbolic capital will erode if not actively maintained. In the case of education, I have already discussed (in Chapter 7) the situation of institutionalized capital eroding over time as schooling systems change and people forget what they learnt in the past. In the case of social capital, he implies that social contacts, once cultivated, must be maintained if the person with these contacts hopes to use them.

For Bourdieu (1986), the link between other forms of capital and economic capital does not mean reducing the relevant (multi-dimensional) field to a purely one-dimensional economic one and so, whilst his conception of social capital does derive from ideas from Marx, it does not adhere to a strictly Marxist framework. In fact, Bourdieu's ideas could be said to incorporate elements from both Marx and Weber – the Weberian element being that status, or symbolic capital in Bourdieu, can offer a useful way of explaining differences between those with similar levels of economic capital. The recognition of an underlying economic element in conjunction with notions of status, however, does allow for a link to be made between the social class of a person and their ability to accumulate **and** deploy both cultural and social capital.

The process of selecting social contacts to help

Bearing this in mind, I note, firstly, that any social relationship a parent has could, in theory, by drawn upon to help a child with mathematics but not all social relationships will be used in this way. Parents will assess the suitability of a social contact for a particular task and, here, I argue, is the main link in my study between the use of social capital and cultural capital. An assessment of suitability will, in some sense, include a subjective assessment by the parent of the level of cultural capital possessed by the person they are recruiting to help. In simple terms, a parent is unlikely to pick a particular social contact to help their child with mathematics if they deem that social contact to have a poor grasp of mathematics themselves. Towards the end of this chapter, I give an example of a parent who has chosen not to seek help from any social contacts because she deems them to be unable to help. She is an illustration of someone who perceives their social network to be unhelpful for the task of mathematics help. Another parent may find that they have a few friends capable of providing help. In the examples below, I examine whether parents who choose to enlist the help of others have explicitly done so because of the mathematical capital that person possesses or the pedagogic capital. Of course, a parent's assessment of another person's capital is a subjective, habitus-based, judgement and, hence, one which depends on that parent's own levels of capital.

Particularly when assessing another's mathematical capital, I argue a parent needs a certain level of pedagogic capital and mathematical capital in order to make an effective judgement about what counts as 'good at mathematics'. A parent with a poor understanding of the modern curriculum may perceive a low level of mathematical capital to be sufficient for helping their child. Similarly, they may perceive a qualification in mathematics higher than one they have achieved to be sufficient.

Deducing levels of social capital

Bourdieu's ideas about capital give us a way of theorising how capital is transferred both from one type to another and from one person to another. He makes a further connection between levels of capital possessed by individuals and the perpetuation of social structures. Those in society with the highest levels of relevant capital tend to dominate particular situations (Bourdieu & Passeron, 1990). I argue here that these groups form because their members have commonality in their experiences and tastes which echoes Bourdieu's views on class. In the earlier QCA results, it was sufficient for some children in certain social classes (and not others) to be of high ability for success in mathematics. Despite arguments to the contrary from some theorists (such as Bottero, 2004), I argue that class is still a relevant indicator when analysing society. To conceive of class as Bourdieu does allows us to link small, everyday actions by individuals with a larger reproduction of culture in society.

In the school context, we could imagine that parents of similar economic and cultural means may raise children in a similar way. I note here that Bourdieu's notions of social reproduction are not determinist as they are often made out to be. Jenkins (1982) suggests that Bourdieu fails to adequately theorise the difference between a social actor's 'subjective internal reality' and objective societal structures and this leads him to unwittingly create a deterministic system where actors are constrained by their levels of capital. I suggest (as does Nash, 1990), instead, that Bourdieu's notion of habitus provides a 'social theory' which links social actions and social structures. Without this idea that internalisation of societal structures as dispositions occurs in people, Bourdieu's notions of capital would be determinist but, as Nash, suggests that dual nature of habitus as a set of internalised dispositions which, in turn, come to create (or reproduce) societal structure shows that the actions of people have a large part to play in creating the societal structures around them.

It is trying, however, to operationalize the above ideas that can cause problems when trying to measure levels of capital. Horvat, Weininger and Lareau (2003) note that much of the literature on social capital and education is quantitative in nature and suffers from a restricted methodological treatment. They propose an ethnographic approach to unearth the mechanisms that produce social capital or show how it is deployed. The problem with a purely ethnographic approach is that it provides only limited opportunities for cross-case comparison. From my earlier QCA results, I saw that children (particularly boys) of higher class backgrounds needed either an interested parent or to be of high general ability to achieve well in mathematics. For children of lower class backgrounds, both an interested parent and high general ability was required. Whilst an ethnographic approach could help me to understand why these patterns appear in the BCS data, I would find it hard to infer that the patterns exist from an ethnographic study alone – unless that study has a large number of cases.

As discussed in earlier chapters, my sampling reflected the earlier QCA work and I selected people to interview who matched some of the types found in the QCA analysis. This allowed me to examine whether the participant had the same outcome as the majority of similar cases in the BCS but also allowed me to examine within that case for potential reasons why it did (or did not) exhibit the same outcome as the BCS data. I, particularly, look for evidence as to whether parents of a higher social class background have more links which they can draw on when a mathematical problem arises and try to ascertain how parents decide who would be a good person to help. I examine whether the choice to utilise a particular social contact has been actively or passively decided. By this, I mean whether a parent has considered many social contacts and chosen one or whether a parent has had the choice almost made for them because of a lack of useful contacts (in the mathematical sphere). Finally, I examine whether those chosen are chosen for their mathematical capital or their pedagogic capital and consider the links between a parent's own mathematical and pedagogic capital and that of their chosen social contact.

Social networks of the interview participants

For the participants in my study, one source of potential social links is the workplace. Of the 18 mothers I talked to, 3 were unemployed and 2 of those mothers were single parents. So, in 2 of the families, the parents had no social contacts from a current workplace. One of the mothers runs her own business with no employees and so also had no workplace social contacts though her husband does work in a factory and does have work colleagues.

Another 3 of the mothers worked in schools for their main job. One of these mothers is a teacher and 2 of them are teaching assistants. Another mother works as a part-time teacher but not in a school setting. The rest of the mothers worked in care (4 of them), in shops (2 of them) and in a hospital lab (2 of them). Some of the mothers had had other jobs in the past and so there is the potential for social links through these but none of the mothers mentioned keeping in touch with previous work colleagues[50].

Two of the mothers in the study were single parents and I have no details of the jobs done by the fathers of these children. I collected details about the jobs of the others fathers and found that they did a wide variety of jobs. One father in the study is unemployed, 2 are factory workers, 2 are drivers, 3 are self-employed, 1 erects marquees, 1 is a roofer, 1 is a nurse, 1 is a security guard and 1 is an insurance broker. One of the families in the study comprises two female foster parents who are both teachers and so, I take into account the

[50] I didn't ask this but I can say certainly that none of them mentioned using any of these contacts to help their child with mathematics.

additional potential social links created in that household from having 2 teachers who both teach in different schools.

So, in all but 2 cases, at least one parent is employed in such a way that they have work colleagues and so, potential social links. Further, some of these jobs are such that a certain level of mathematical capital is needed to do them (even if that is not always in the form of formal qualifications) and so, these parents are likely to have access to those with similar or higher levels of mathematical capital to themselves through their jobs. More importantly, I suggest that those who work in schools (not as teachers themselves necessarily) or those with access to teachers as personal contacts could gain access to institutionalized pedagogic capital from these contacts.

Another source of potential social links, and institutionalized mathematical and pedagogic capital, is found within families. I cannot map out here all the potential familial ties that parents in the study have but I do consider older children to be a source of social capital here. As we see later, some parents consult their older children when a younger child has a mathematical problem.

I also consider cases where a parent has used a social link who is not a family member or a work colleague and examine whether the decision to contact this person has been made solely because of the perceived levels of capital of that person. A parent may choose to consult, for example, a family member because of the ease of asking them but contacting someone outside the family unit may require specific targeting of that individual.

All these choices are bound up in the parent's own levels of capital because assessing another person's level of capital requires a subjective judgement by a parent. The reason I link this judgement to the parent's own levels of capital is because I see this judgement process as taking place within a 'reference group' which is habitus-based. Merton (1968) argues that reference groups are important in the formation of social norms because members re-align their behaviour to comply with what is normal for that group. I do not use precisely this reasoning here but, instead, argue that a parent's social circle provides them with a reference group from which to ascertain what level of achievement is considered average, poor or exceptional for their child. I posit here that a level of pedagogic capital is essential to facilitate help if the parent chooses to act as an intermediary between their chosen social contact and their child. This pedagogic capital may even eradicate the need for a high level of mathematical capital. On the other hand, those with mathematical capital, if not combined with pedagogic capital, cannot always navigate problems in their child's understanding of primary mathematics – despite their levels of mathematical capital being, sometimes, very high.

Social contact giving help directly to the child

Joanne was the only parent whose social contact gave help directly to the child and who was paid to do so. The woman chosen to help was already known to Joanne's daughter and this played a role in Joanne's decision to ask her. The woman was also selected because she had institutionalized pedagogic capital from her role as a learning support assistant but it is not clear how high the woman's levels of mathematical capital are.

Joanne: We paid someone to come in the summer holidays, 2 days a week, to help her with her maths.

Interviewer: Ok so, like a tutor?

Joanne: Yeah, just for her confidence really. I don't know if it helped with her maths. She just wasn't as scared going into Year 4 because she knew she'd had that extra help... It's someone who... It was her learning support at school we paid to come and help her so...

Interviewer: So someone she knew already?

Joanne: Yeah, if it was someone different then she probably wouldn't have done anything.

Joanne, intermediate-class, Bankhill

Joanne admits that she is unsure whether her daughter's mathematical understanding improved but is certain her daughter's confidence was greater and, therefore, her daughter was less nervous about returning to school after the summer holidays. For Joanne, who also has some learning difficulties and low levels of mathematical capital, the sourcing of an external person to help her daughter provided her daughter with specific support that Joanne herself could not provide.

For Clare, the reasons for seeking help from a family member were less explicitly focussed on the person selected to help but more on her worries about not being able to help herself.

Oh aye, he loves maths. He does. It's awful because I can't help him with maths. Sometimes I can, sometimes I can't.

Clare, working-class, Oscar Road

She described her own experiences of education as difficult and recalls being told she was of low ability before having to change school. She has very little confidence in her own ability to help and has to take it on trust that her child has done homework correctly.

He had homework for the day and he did it before he went to school. And he said, 'I know that, I know that' and I said, 'I believe you then'.

Clare, working-class, Oscar Road

For parents like Joanne and Clare, who consider their own levels of cultural capital to be prohibitive to helping their child, contacting someone outside their family who does have what they consider to be the appropriate levels, types and forms of cultural capital to help can be a way to bypass their own lower levels. In cases like Clare's, where the parent has such low levels of mathematical, pedagogic and linguistic capital and low confidence, parents may be willing to accept help from anyone else because they perceive that someone else must have higher levels of capital than them. Other parents, with higher levels of cultural capital, choose to act as an intermediary between their social contact and child.

Social contact giving help through parents

One of those who selected relatives picked a family member who was studying a higher level of mathematics. Helen explained that she is finding it possible to help but had contacted her sister-in-law, a mathematics undergraduate, when her older daughter was struggling.

Helen: There has been one time with the older daughter that we did actually ring my sister-in-law who's doing a maths degree.

Interviewer: Okay.

Helen: 'Okay, explain this because we don't understand.' And she did do it for her – she just explained it in a different way to the teacher had explained it, in the book.

Interviewer: And that's...

Helen: And we got it.

Helen, working-class, Bankhill

Though she counted this as a successful instance of receiving help, she was reluctant to disrupt sister-in-law's studies and would only consider asking for help if she felt that it would not be burdensome.

Interviewer: Would you probably rather try and ask her or ask the school, do you think?

Helen: Um, that would depend on whether or not she was studying for exams. If she was studying for exams, then I wouldn't want to pester but then [pause] if it was a point where she wasn't then it would be, 'Ok, quick call, just explain to me how to work this out'.

Helen, working-class, Bankhill

As Bourdieu (1986) suggests, social networks must be maintained to be useful and I suggest that Helen's reluctance to ask for help too often or at a difficult time is because she wishes remain on good terms with this social contact. If this relationship was to break down then, as her source of help is a family member, it could have broader implications for her social network. It would also, of course, cut Helen off from a potential source of help for her child. Here, Helen, like some other parents I discuss below, shows that she is the one who has approached her relative for help and asked for the explanation so that she can pass it on to her child.

Mary sometimes acts as an intermediary between her older child and younger child when she is unsure about something in the younger child's homework. She admits that she did not consider the older child to be particularly good at mathematics and that she also had to help him sometimes but, there were occasions when she would get the older child to explain the question to her so that she could explain it to her child.

Mary: I have learned a lot more on fractions and your percentages but, at the same stage, when [he] brings his homework home and I don't understand, then he'll explain it to me and then I can pick it up quicker and I can learn it at the same time. Certain, just now and again, once in a blue moon, he'll bring something home and I don't know.

Interviewer: And is that, have there ever been some of the things that he doesn't know and then you don't know? What would happen in that situation?

Mary: We ask the older brother.

Mary, working-class, Oscar Road

For Mary, the use of an older child seems to be for reasons of convenience as she explains that he has not been chosen to help because he has high levels of mathematical capital. She uses helping the youngest child as an opportunity to increase her own mathematical capital. Mary, who works in a care home, may lack other social contacts to ask about her child's difficulties with mathematics. For those who work in schools, however, there is a large group of work colleagues with the relevant institutionalized cultural capital to draw on.

Of the 3 parents who asked work colleagues for help, 2 of those worked in schools and accessed help from teachers. These 2 parents are not teachers themselves but offer learning support in schools and therefore personally know many teachers. Karen explains that she targets particular work colleagues when she is looking for help for her child.

Karen: You can tell who's a maths person and who's not. I think he's like me: he can do it but you have to work at it. You have to think about it. And I mean, I know at work when I can't help him, I know which teachers to go to – the maths-orientated ones.

Interviewer: Yeah, and that's really... You're really lucky, I guess, because you're in a school – you're in that setting – you can find these people. Have any of them ever come to help him with it or have you just...

Parent: They've explained it to me and I can pass it on. Because if I can't understand it, I can't, you know, show him.

Karen, intermediate-class, Bankhill

Like Helen and Mary, Karen chooses to obtain the information herself and then pass it on and feels that she must understand what she is passing on. Thus, she is also raising her mathematical capital by asking for this help for her child. Karen found that this system helped her to explain things to her child. In contrast, Paula asked some of her work colleagues and found their method to be different to the one her child was being taught.

Yeah, there are times when I've sent a note into school and said, 'Can you show me how you've shown the workings out?' because there was something he was struggling with at school and I actually asked in here [school parent works in but not the same one her children attend] but, obviously, it was taught differently here, some primary schools teach them in different ways. Erm, so I struggled a little bit with that. So, I go into the teacher now and say, 'Can you show me how you do it?' then he shows me his workings out and I can help [him] at home.

Paula, intermediate-class, Oscar Road

Instead, she now approaches her child's teacher directly but still channels the information through herself, preferring to understand what the teacher is doing before explaining it to her child. As with Sharron, I suggest Paula's pedagogic capital makes this interaction with teachers easier. In addition, Paula's social network contains many teachers and, in a sense, multiplies the pedagogic capital she already possesses.

The third parent to consult work colleagues was Ruth. Like Mary, Ruth does not work in a school but she does work with the mother of a child in her child's class and she sometimes asks this mother about the homework. Ruth explains that she asks this woman mainly because of convenience but also that she perceives her work colleague will understand her struggles because their children are in the same class.

But, with working together, sometimes we talk. We talked today, actually, about the homework what they had on Monday. As it was, they'd had different homework but, er, but yes, I think we do tend to talk sometimes but because it's convenient, really, to do that.

Ruth, intermediate-class, Rutherston

She explained that they chat about the homework in general and how their children are doing at school at work but also that she has contacted her work colleague outside of work time when a particular problem arises.

Interviewer: So you phoned a friend who's got a daughter in the same class. Have you ever asked anyone else? Any other relatives or friends?

Ruth: No, I tend to phone this one particular woman because I know her daughter's in the same class so we tend to…

Interviewer: And she's the, sort of, person that you pick because you know her personally…

Peter: She works with her!

Ruth: And our daughters are in the same class so we know, that homeworks tend to be roughly the same.

Ruth and Peter, working-class, Rutherston

For Ruth, she picks her friend to help because their daughters are both in the same class at school and anticipates that the work the children are being set will be the same. She does not explicitly appear to have taken into account the level of mathematical capital this colleague has but privileges the convenience and familiarity with her child's school that this contact offers. I suggest that, in some sense, there is an unequal relationship between the two mothers. It could be that her colleague is either having fewer problems, is more able to solve problems within the family unit or is going elsewhere for help. The first two scenarios suggest that Ruth's work colleague has more mathematical capital within the family unit than Ruth. The third scenario suggests that the work colleague has access to someone else with high levels of mathematical capital. Whichever of these is the case, Ruth does not appear to be the person her work colleague would primarily approach for help.

What we can see here is that, in most cases, parents are transferring social capital into institutionalized mathematical and pedagogic capital and then transmitting this to their children. This chain of events breaks down if a parent is unwilling or unable to transfer the social capital to mathematical capital or if the parent is unable to transmit the capital. In both these situations, the social capital can be transferred directly to the child and converted into mathematical capital. Even, then, in situations where parents have sought help because the work they are faced with is (or they think it is) beyond their capabilities, mathematical capital is being gained and transferred.

So, even though here, I have analysed instances of deployment of social capital and cultural capital separately, they appear, in the case of mathematical capital and helping with homework, to be intertwined. The quality of help available in a parent's social network is important too. Several parents looked for someone who had a high level of mathematical capital when selecting who to ask for help but, such people would not be available to all parents. Some people, like Mary, have to settle for help from someone they have rated as not good because of a lack of other options.

Where social capital is not used

Some parents were reluctant to use social capital at all. Suzanne is the work colleague of Ruth, mentioned above, and talked about discussing homework but not seeking help.

Interviewer: Do you have anybody that you can ask for advice about these things? Do you have anybody, do you talk to other people about some of the homework or about some of the general issues of education?

Suzanne: Erm, just some of the girls at work because [another child]'s mum, I work with quite closely with her so it's all like, 'What did you think of the homework at the weekend?' type thing. But, apart from that, we don't really talk…

Richard: Not for any advice.

Suzanne and Richard, intermediate-class, Rutherston

Richard was keen to emphasise that they did not consult others for advice or help. Both Richard and Suzanne are professionals with academic jobs and recounted many investments that they had made for programmes to help their younger daughter with mathematics. For them, the difficulties at home arose from the methods that the school used. They also suggested that they did not completely agree with the way their child was being taught.

I think there's a lot of the word problems that I've seen [her] tackle or I've seen, the ones that I've come across. I always think there's a… It's a difficult… If it's written in English that isn't accessible to them, given their level of comprehension, then it becomes doubly difficult. They can't see the context that a) the maths, the abstraction, the maths is trying to equate to and they just don't understand the English either because it's not written for them based on their view of what they're supposed to be doing in the first place.

Richard, intermediate-class, Rutherston

In this excerpt and others where he talks about how his child is taught, Richard is hesitant and reluctant to explicitly criticise but it is clear that he is uncomfortable with some of what his child is being asked to do. He refers to his own experience of returning to learning and argues that his child should have more examples to work from.

I think, from my point of view, I would say, from an adult learning point of view, the material I come across now, there's a lot more, erm, there are a lot more examples to be had, to reflect upon when you're doing the work, to refer back to than what I find comes back from school. So, whereas, you have a sheet of paper with, perhaps, one or two examples on it, then you have a dozen or so of 'get-on', the examples themselves. I still don't, I still don't find there's enough, particularly in [child]'s case, which I'm sure it's a contextual thing, and a confidence thing. I think she's, my interpretation, my impression is that she would do a lot better with much more examples…

Richard, intermediate-class, Rutherston

This reasoning, drawn from his own experience, describes a very personal learning process without much social interaction so it is perhaps no surprise that Richard and Suzanne are less keen than others in the study to approach others for help. It could also be, however, that they do not want to admit to other families that they are struggling. In informal interactions between the parents during the mathematics workshop, I observed that Suzanne was quite open about her husband's mathematical aspirations and told me in front of others that he was studying undergraduate mathematics. It could be, then, that Richard and Suzanne do not feel that there is anyone among the parent body that possesses the mathematical capital that they have within the family. Despite having a father who is studying mathematics to a high level, their daughter does struggle with mathematics but, so far, Richard and Suzanne have only tentatively approached the school for help.

Suzanne: We've asked what we can do to help her but, I don't know, you don't really get that much constructive advice really.

Interviewer: Have you ever felt like you have to come in and ask, because of a particular thing? Maybe she's not understanding a particular thing and it's been in a few homeworks. Have you ever come to the school and asked about that sort of thing? Is that something you'd consider doing?

Suzanne: I think it was nearly at the stage where I said, 'I will come in' and 'No, no, don't come in, don't come in!', didn't she?

Richard: We considered it.

Suzanne: We considered coming in but I didn't want to upset [her] by coming in and, maybe, singling her out.

Richard and Suzanne, intermediate-class, Rutherston

Richard and Suzanne have also purchased a subscription for a mathematics website and group tuition for their daughter in mathematics but neither of these ultimately impressed them. They explained that both the tutoring and the website were repetitive and that their daughter grew bored with them.

They put whistles and bells on it and this, that and the other but it's pretty uninspirational. Again, I think it's contextual. Once they get the procedures under their heads and they know what it is then I think they look for better things. Whereas in those packages you're seeing, maybe again like the Kumon one, they're getting into it and then, they reach that particular step and given what their characters are, you can push [her] so far but she just puts the wall up and then she'll just forget it. She won't be interested and, yet, as I say, in the first instance, that Kumon thing is quite impressive, you know? Mental addition of 2 digits is just [clicks x 3], doing it straight away but then it gets boring.

Richard, intermediate-class, Rutherston

Richard and Suzanne have, then, used mathematical capital and economic capital when trying to help their child but there are no signs of using any social capital and some hints that they might not be keen to do that. Another possibility here is that, because of their professional statuses, Richard and Suzanne may not be keen to admit to wanting help from others. I suggest that they may be worried about social stigma. For Goffman (1963), social stigma is a negative reaction by a group to behaviour or characteristics deemed unsuitable by that group. So, Richard and Suzanne may be worried about admitting to their friends that their daughter struggles. It could also be the case, however, that they have simply made judgements about the capabilities of those in their social networks and deemed them unsuitable for helping. If this is the case, their decision echoes that of Irene in Chapter 7 who, because of her high levels of pedagogic capital, did not want others to show her child how to answer mathematics questions 'the wrong way'. Irene is more explicit in her reasons for not wanting to deploy social capital to help her child because of her belief that her institutionalized pedagogic capital makes her the best person for her child to approach with problems.

Interviewer: And do you have anyone else at home who might help them out? Like another relative or anybody that you know?

Irene: I think they would probably try but they'd get better answers from me than anyone else.

Interviewer: Okay, I think that's quite common, though, with lots of families. There's always… Kids, kind-of, quickly pick up on who's the best person to ask sometimes…

Irene: Yeah, I think also with me, obviously, with me working here, I know how the school would want her to do it therefore I wouldn't want anyone else teaching her how to do it the wrong way.

Irene, intermediate-class, Oscar Road

She is concerned that other people, in trying to help, would actually give her child misleading instructions because they would not be aware of how the primary school was teaching a particular area. What is less clear is whether Irene has ever deployed social capital within a work setting to overcome a problem that she cannot solve within the family, like Karen did. She does describe her daughter as rarely needing help, however, so it could be that her levels of mathematical capital and the specific knowledge of school methods have been enough to help in any problematic situation that has arisen so far.

All the examples so far relate to parents using social capital to access additional cultural capital. I argue that those who work in schools, and so have high levels of institutionalized pedagogic capital already, are in a good position to multiply these levels of capital through their social networks. We have seen above that this strategy proves helpful when parents struggle to help with homework themselves. In the next sub-section, I discuss a particular parent's alternative strategy to influence how aware teachers were of her child at school.

<u>Social capital at work in the school</u>

Elaine's strategy

Elaine, a school volunteer, became concerned that her child was falling behind his classmates quite early in his primary schooling. We have seen, in Chapter 7, that she sought out courses to raise her own levels of mathematical capital so that she could help him but she also chose to become a volunteer in the school to raise his profile among teachers.

In reception, Year 1, it wasn't a big issue but then when I realised he was falling really quite far behind a lot of the pupils in his class, and I didn't feel that he should be, that I got a tutor for him and it wasn't… The tutor was really nice but it wasn't bringing him on enough. I just thought, if I get involved in the school, at least I'll know what he's doing, what stage he's at and how I can help him and so, in a way, get him noticed... Because he's a very quiet little boy, he's in Year 5 now, but he's still shy and quiet. But because I've worked with all the teachers, I think they're more aware of him. I was saying this to my husband, not that they treat him any differently but they're more aware that he's there.

Elaine, intermediate-class, Oscar Road

Her intention, then, with the volunteering was to gain more specific knowledge about the practices of the school but also to use her social capital and professional relationships with teachers to ensure that he was not overlooked in the classroom. This example is very different from the others in the study because it shows a parent trying to influence events in a school setting and not just in the home. Elaine was concerned about her son's demeanour and thought that he may be overlooked for help in the classroom because he was not as forceful at asking as, perhaps, the other children around him. Instead of solely trying to focus on activities in the home, she tried to affect a change in the attitudes of teachers towards her son by using her, newly acquired, social capital. This is also a less confrontational strategy than could be employed. We could conceive of a parent worried about the same things as Elaine who approaches the school directly and asks for their child to receive more help.

I argue here that such a strategy may not be as successful as Elaine's because teachers could see a parent's concerns as an attack on their professional capabilities and may question the fitness of a parent to criticise what happens in school. The concern of parents in this study that a child may get confused by conflicting methods at home and in school is echoed by teachers in studies by, amongst others, Lareau (1987). She found teachers, in general, extolled the benefits of parental help at home but 'desired parents to defer to their professional expertise' (Lareau, 1987). This could be interpreted as doing activities in the home that are suggested by the school rather than spending time on self-devised activities. In taking some teaching qualifications and offering to volunteer in the school, I argue that Elaine is attempting to place herself on a more equal footing with the teachers in the school. Her work in school will allow her to gain an insight into school life that other parents may not have and will allow her to form work relationships with those teaching her son.

For Sharron, who was discussed in Chapter 7, the shared understanding of what it means to be a teacher has allowed for interactions with the school which are easier for both her and the school.

It's really valuable because I can go in and say, you know, I don't really think he is this level yet. I think we need more work on it. And you, you've got the mutual respect. We're very close with the school anyway, you know, we go in, we know the people so it's not a problem, within your relationship, to question either. But obviously there's that mutual respect that we do, both [my partner] and I do know, you know, how it's working and how it fits together and what basics he needs to be able to move on to the next level.

Sharron, intermediate-class, Churley Park

I suggest that both Elaine and Sharron have, because of their levels of institutionalized pedagogic capital, the potential to have more interactions with teachers in general and also more successful interactions with regard to specific problems their children are having. In Elaine's case particularly, the use of social capital has allowed her to influence not only their interactions in the home but also in school.

Summary

In this chapter, I have examined the wide range of social contacts that can be called upon by parents when their child needs help with mathematics. Some of these contacts may be from within the family but, sometimes, those external to the family are chosen to provide help. The act of deciding who should provide help requires a judgement by parents of the capabilities of a range of candidates and, thus, is a judgement influenced by a parent's levels of cultural capital. For some parents, however, the idea of a choice of candidates is illusory because their social networks are limited. These parents may not have made a judgement about capabilities but, instead, consider availability.

Using the interview data, I initially examined an instance of parents using their social capital to find someone to directly help their child. For the other cases where social capital was used, the parents acted as an intermediary between the person helping and the child. In the sample, there are some parents who use work connections and some who use family connections but, the biggest difference, is between those who contact teachers (not necessarily at the school their child attends) and those who ask people they perceive to have high levels of mathematical capital.

I have also shown, using an example, how parents may employ strategies to indirectly influence the academic progress of their child. For Elaine, the decision to use her (newly acquired) social capital was deliberate and articulated. For other parents, such as those who seek help from older children, the decision to use social links to help their children is more hidden in everyday social interactions.

I suggest, in this chapter, that those parents with already high levels of institutionalized pedagogic capital benefit from increased access to teachers and other educational professionals and, as such, can multiply their levels of capital through social links. This fits with Bourdieu's ideas that social capital serves to boost the levels of capital that someone already has. The converse of this idea is that those with already low levels of cultural capital may find it difficult to access, through social networks, those with higher levels who may be able to help their child. In this study, only 7 parents reported using social contacts to help their children and 4 of these were people with already high levels of pedagogic capital. I would be interested to explore, in further research, whether parents with already high levels of cultural capital do seek help through social contacts more often than those with low levels of cultural capital in a larger sample.

Conclusion

This study was an investigation into parental involvement in primary school mathematics which aimed to examine if parents from different social classes provided different help and why this may be. I was particularly interested to find out if, for some children and not others, parental interest was sufficient for high attainment in mathematics.

I took an innovative, mixed methods approach to studying this area and analysed both a large-n, longitudinal dataset and interview data from a small sample. Choosing to analyse both these datasets from a case-based perspective allowed for types of parents in the interview sample to be mapped on to types in the longitudinal data.

Using QCA in the way I have here is relatively unusual. When Ragin developed QCA, it was originally for the analysis of small- and medium-n datasets and, although Ragin himself did show that QCA can successfully analyse larger datasets, there are still very few researchers choosing to use it in this way. A substantial contribution to the development of QCA on large-n datasets comes from Cooper and Glaesser (e.g. 2008) who investigate educational attainment in selective and non-selective education in both Germany and the UK.

In Chapter 1, I explained how mathematics has become placed at the centre (along with English) of the UK curriculum and is a subject that can guarantee access to the best educational opportunities and jobs. I termed it, in Chapter 1, a ‘social filter’ and suggest that those lacking in mathematical capital (usually of the institutionalized form) can be denied the same opportunities as those who possess this capital. In the primary school context, which is my focus, mathematical capital is important for access to, for example, the top sets in secondary school and then higher-level GCSE bands.

In Chapter 2, I discuss the role of parents in educational generally and mathematics specifically. I suggest that, broadly speaking, parents are expected to give an increased level of help to their children in contemporary schools and that this can lead to some tension about what is considered legitimate knowledge. I argue that, particularly with school mathematics, there is the perception (outside of the mathematical community) that mathematics is a subject of absolutes where answers are either right or wrong and there is no middle ground. Parents, then, under increasing pressure to contribute to their child's learning in the home, may find that their knowledge and skills do not match the officially presented version and therefore that they are less able to help than other parents.

In Chapter 3, I propose that differences in levels, types and forms of capital may account for the differences in action of parents in relation to helping with mathematics. Drawing on Bourdieu's (1986) notions of capitals, I suggest that cultural capital can be of several different forms and types. I focus heavily on institutionalized capital as this is the form associated with formal schooling and suggest that the presence of institutionalized capital in combination with any other forms is what characterises formally learnt knowledge. I suggest that looking for evidence of different types of cultural capital in my interview data could help to explain differences in parental help. This is because, I argue, the levels, types and forms of capital influence the habitus of a parent. And since I, additionally, argue that social class position is a summary of these levels of capital, this provides a theory of why class position could be linked to differences in action.

In Chapter 4, I outline some research areas for detailed exploration in the thesis. Namely, I pose the questions 'Is parental help sufficient for attainment in mathematics for some children and not others?' and 'Do parents of different social classes provide different help in mathematics?' I suggest that the first of these questions can be addressed by conducting QCA on the BCS70 data and the second through a detailed analysis of the interview data.

In Chapter 5, I explain how QCA is conducted and note that there are several places in the analytic process that require judgement by the researcher and, hence, careful consideration. I explain, with the use of example data and some real BCS70 data, how to calculate the consistency values of rows in a truth table and what level of consistency is appropriate to consider as a threshold in an analysis of sufficiency. I then explore the problem of limited diversity in the QCA context and evaluate two proposed solutions to it. I showed that one proposed solution is flawed and then suggest that, in contrast, counterfactual reasoning provides a way to overcome limited diversity without over-simplifying the results of analysis.

In Chapter 6, I present the analysis associated with the first question raised in Chapter 4 – 'Is parental help sufficient for attainment in mathematics for some children and not others?' I explain how I constructed a theoretically grounded model and show, firstly, some results which do not take into account the general ability levels of the children under examination. After refining my model to include general ability, I then have to contend with limited diversity in the data and must use counterfactual reasoning to produce solutions with only the theoretically-justified remainder rows left in. I also, in this chapter, analyse data on the interviewees using QCA to give an overview of the interview sample. Crucially, I use the QCA results from the BCS70 data to select interview participants by thinking of the configurations in Chapter 6 as types who warrant further explanation.

In Chapter 7, I tackle the second question raised in Chapter 4 – 'Do parents of different social classes provide different help in mathematics?' I analyse the cultural capital levels of parents in the interview sample and differentiate help into that which is (seemingly) successful and that which is unsuccessful. Firstly, I discuss the help given from grandparents (Generation 0) to parents (Generation 1). Secondly, I discuss the help given from parents (Generation 1) to children (Generation 2) and examine which levels, types and forms are present in those parents which have successful or unsuccessful experiences of giving assistance.

In Chapter 8, I examine whether parents can use their social capital to compensate for any forms, levels or types of cultural capital they lack. This discussion, restricted to an examination of social capital in parents (Generation 1) explores Bourdieu's notion that social capital acts as a multiplier for cultural capital. With this in mind, I examine who parents choose and how they choose this person to help their child with mathematics noting that their own levels of cultural capital are likely to impact on their choices. A parent's levels, forms and types of capital are also important when the parent chooses to act as an intermediary between their social contact and their child. If the capital is being transferred through the parent, they must not have prohibitively low levels of pedagogic capital. I also examine some cases of parents who choose not to seek help from social contacts and suggest that they may not want others to think they have inadequate levels of capital to help themselves. Finally, I examine one case in detail where a parent went to work in her child's school to acquire social contacts to help him.

Key findings - substantive

Some key substantive findings from my study relate to how the type of parental involvement offered by parents relates to their social class position. As I discussed in Chapters 1 and 2, the onus is now on parents to provide additional help, especially in mathematics because of the high-status and general educational opportunities associated with competence in mathematics. Parents in my interview sample felt under pressure to help their children reach a certain standard of mathematical attainment because they were worried that, if they did not, their future education would be compromised. I showed in Chapter 3 how a theory of capitals allows us to link social class position to the specific skills required for successful involvement in mathematics (i.e. leading to high attainment) and suggested that those skills associated with successful transmission of information, like pedagogic capital, were important to consider when analysing episodes of parental involvement in mathematics.

In Chapters 4 and 5, I outlined how I proposed to investigate social class differences in help with mathematics. I showed how using QCA on the BCS70 allowed me to compare the help offered to parents (Generation 1) and the help they offered for their children (Generation 2). I explained how QCA is conducted and discussed several of the decisions about calibration and threshold-setting that researchers must make in order to analyse data in a sensible way. I also expanded on some work in Thomson (2011,in press) which compared two methods for combating limited diversity.

In the interview data, I found that those with high levels of pedagogic capital (or links to high levels of pedagogic capital through their social contacts) were able to solve specific problems with mathematics homework more easily than those without. I suggest that this is because those with high levels of pedagogic capital have, or have access to, institutionalized capital in mathematics and, therefore, are more able to see past what a particular homework question asks and deduce what, more abstract concept, is being tested.

I talk, in Chapter 3, of how institutionalized capital in mathematics represents a small sample of all mathematical knowledge but, crucially, is the kind of mathematical knowledge rewarded with qualifications and prestige. Parents in my interview sample who wanted to help their children recognised that a certain level of competence and skill, or cultural capital, was required to do this and many who perceived their own levels of mathematical capital to be too low to help effectively chose to raise their levels of mathematical capital by attending various courses. I suggested, in Chapter 7, that not all of these courses proved equally helpful for the specific purpose of helping struggling primary school children with mathematics. Some of the courses, those run by primary schools, offered access to institutionalized mathematical capital and, often, linguistic capital associated with mathematics.

Parents, however, may have an inaccurate judgement of their own capabilities because they do not have high enough levels of capital to make an accurate judgement. One of the reasons I use a theory of multiple capitals to try to explain the type of help parents give to their children is to move away from a simplistic analysis based on educational qualifications alone. I show in Chapter 7 that parents often use a wide variety of mathematical skills in their jobs but that not all of these are associated with high enough levels of institutionalized capital to help their children. So, in effect, while they may have mathematical knowledge at an equivalent level to that in the primary curriculum, they do not necessarily have the specific knowledge required to help with particular questions.

One of the particular facets they may lack can be represented by another form of capital: linguistic capital. I noted in Chapter 7 that some of the parents interviewed struggled when faced with the words used to describe concepts or teaching methods and this caused them to question their suitability to help. Low levels of mathematical linguistic capital may also limit the parent's ability to explain a concept to their child in terms that the child can understand. I am careful to stress here that I do not see these levels of capital as linked to innate intelligence or the parent's mathematical capability more generally. Instead, I suggest that some parents cannot, in linguistic interaction with their child, reconcile their mathematical knowledge with that of the primary mathematics curriculum and cannot transfer what they do know to their children in a way that leads to higher attainment.

Of course, as I explored in Chapter 8, if the parent has low levels of, for example, institutionalized mathematical capital then they may overcome this by drawing on social contacts to provide the help for their child that the parent cannot provide. I explored, in Chapter 8, who is called upon to provide help and how these people have been chosen. I discuss how a parent's own levels of capital influence who is chosen because, as explained above, their ability to judge who is able to help is bound up with their understanding of the differences between institutionalized capital and more general mathematical capital.

Most usually, in the interview sample, people were chosen to help because of some qualifications they had or the job that they did. Teachers were often called upon to provide guidance and, in my sample, I saw two specific examples of this. One was where a learning support teacher was paid to help a child over the summer and another involved a parent (who worked in a school but was not a teacher) asking a teacher to explain a concept to her so that she could, in turn, explain the concept to her child. The latter parent was able to communicate what she had been told successfully (to the point of overcoming the particular problem) because she had a high level of pedagogic capital.

Another source of access to institutionalized capital for parents lies with older children who were sometimes called upon by parents in my sample to help with specific homework questions in mathematics. This is an area that I was not able to explore fully in this study but one which could provide an interesting area for future research. It would be useful, I suggest, to explore whether types of parents who share the same characteristics except for the presence/absence of older siblings would approach parental involvement in different ways.

Before turning to the methodological aspects of my study, there is an important point to be made concerning policy interventions in education. Research using conventional methods is often reported as if a single lever is available to achieve desired policy outcomes and, furthermore, as if moving this lever will be equally effective for all recipients of the policy who are seen as a set of undifferentiated cases. What my work suggests is that, given the quite different types of parents, there is in fact a need for policy interventions to be mapped on to these types. Clearly, a case-based approach such as that made available by

QCA has the capacity, when used in conjunction with process-tracing in depth interviews, to provide type-specific recommendations for policy makers.

Key findings - methodological

As well as the substantive findings, I explored some methodological challenges arising from the use of QCA on large datasets. I devote a large part of Chapter 5 to discussing how limited diversity can arise in a dataset of any size and that it is a general problem of social research. One of the strengths of QCA, as a method, is that a researcher is required to justifying their decision-making process throughout whether about setting consistency thresholds or overcoming limited diversity.

I showed in the thesis, as in Thomson (in press), that, in this evolving method, there are two main proposals for dealing with limited diversity. One of these involves partitioning the model under study so that QCA is performed twice on fewer factors at a time in each case. I argue that this approach obscures complexity from the researcher and can lead to over-simplified results. Using real and invented data in some examples, I show that this ‘two-step method’ has a structural weakness in that it does not allow all the relevant factors in the model to interact with one another and, therefore, produces configurations which are missing some factors thought to be causally important enough to study in the first instance.

Though the originators of this method, Schneider and Wagemann (2006) seek to use the ‘two-step approach’ in a very specific capacity to analyse political science data, they do imply that such an approach could be extended. Mannewitz (2011) is more staunch and argues that the ‘two-step approach’ can and should be used whenever limited diversity is present. My rebuttal of these claims adds to the debate, between users of QCA, about the most appropriate way to analyse datasets where limited diversity is present. I conclude, in

Chapter 5, that an alternative approach, using counterfactual reasoning, does not suffer from the same faults as the ‘two-step approach’ and, additionally, requires a great deal of researcher input and careful thought which is within the general spirit of QCA.

The counterfactual method requires the researcher to examine not only the likelihood of the remainder row in question achieving the outcome but also the impact that including the row will have on the solution. This draws sharply into focus the effect that a single row can have on a simplified solution and proceeding in this way means that the researcher has to be able to justify the inclusion of exclusion of a row. The work in this study, particularly in Chapters 5 and 6, shows that the application of the counterfactual method for large datasets differs from the instructions given for it by Ragin (2004). One key difference is that, in large datasets, remainder rows may still contain cases whereas, for small-n studies, they are usually considered to be rows with no cases at all. Allowing remainder rows to contain cases leads to their having consistency scores which may produce a misleading view of how the row would behave were there more cases in it. This happens, via sampling error, when the cases in a particular sample attain the outcome in question more often than in the general population. I argue, in Chapter 5, that a threshold can be imposed in much the same way as for consistency values in a general QCA which marks that boundary between rows which are not remainders and rows which are. I suggest that this boundary should be treated in much the same way as the consistency threshold i.e. it should be flexible and rows on the borderline must be treated with extreme care.

The work in Chapters 5 and 6, then, makes a contribution to the methodological development of QCA, in relation to large datasets particularly, and suggests that using counterfactual reasoning to combat limited diversity is preferable to the other approach argued for in the literature, namely the two-step method. Future research could compare this researcher-led approach in QCA to the analysis of large datasets by other more standard statistical approaches to see if the effect of a small number of cases is, using these other methods, hidden and, therefore, not easy for someone interpreting such results to detect.

Potential weaknesses of the study

Though the comparisons between my small-n interview sample and the large-n longitudinal data have allowed me to suggest reasons why some parents are involved differently to others, a larger interview sample would have allowed me to make more comparisons. I would have liked to have interviewed more fathers so that the interview stage was not so strongly focussed on the involvement of mothers but it was difficult to find fathers willing to participate in the study. Interviewing more fathers would have allowed me to explore whether the differences in mathematics attainment by sex found in the BCS70 data had an impact on the mathematical confidence of different sexes of parent.

I would also have preferred to have had access, within the BCS70 dataset, to a social class classification which mapped more directly on to Bourdieu's theoretical framework of capitals. However, I was constrained to make use of the Registrar General's classification that was in use at the time. This is known to have some weaknesses from a sociological perspective (as discussed earlier).

Summary

In this thesis, I have combined an innovative methodological approach to the analysis of large-n data with a detailed examination of interview data. I showed, using QCA, that there are social class differences in the sufficiency of parental involvement for mathematics attainment. Given this finding, I wanted to explore why this may be and argued, drawing heavily on Bourdieu, that social class position is a summarising of levels, types and forms of capital and that differences in levels, types and forms of capital between parents explain, through their different habituses, why the help they give their children is different and, often, differently effective.

Bibliography

Abreu, G. d., & Cline, T. (2005). Parents' representations of their children's mathematics learning in multiethnic primary schools. *British Educational Research Journal*, 31(6), 697-722.

Abreu, G. d., Cline, T., & Shamsi, T. (2002). Exploring ways parents participate in their children's school mathematical learning: case studies in multiethnic primary schools. In G. d. Abreu, A. Bishop & N. Bishop (Eds.), *Transitions Between Contexts of Mathematical Practices* (pp. 123-149). Dordrecht: Kluwer.

Alexander, R. J. (2000). *Culture and Pedagogy: International Comparisons in Primary Education*. Oxford: Blackwell.

Alexander, R.J. (2011,). Primary schools need a broad curriculum. *Guardian*, accessed online at: http://www.guardian.co.uk/education/2011/mar/15/national-curriculum-ministerial-meddling, 15th March.

Apple, M. (2002). What Policy Can Learn from the Math Wars. *Educational Policy* 16(3), 448-456.

Atweh, B., & Cooper, T. (1995). The construction of gender, social class and mathematics in the classroom. *Educational Studies in Mathematics*, 28, 293-310.

Austin, J. L., & Howson, A. G. (1979). Language and mathematical education. *Educational Studies in Mathematics*, 10(2), 161-197.

Bakker, J., Denessen, E., & Brus-Laeven, M. (2007). Socio-Economic Background, Parental Involvement and Teacher Perceptions of these in relation to Pupil Achievement. *Educational Studies*, 33(2), 177-192.

Berger, J. O., & Berry, D. A. (1988). Statistical Analysis and the Illusion of Objectivity. *American Scientist*, 76, 159-165.

Bernstein, B. (1964). Elaborated and Restricted Codes: Their Social Origins and Some Consequences. *American Anthropologist*, 66(6), 55-69.

Bernstein, B. (1977). *Class, codes and control: towards a theory of educational transmissions (Vol. 3)*. London: Routledge.

Bibby, T. (2002). Shame: An Emotional Response to Doing Mathematics as an Adult and a Teacher. *British Educational Research Journal*, 28(5), 705-721.

Biernacki, P., & Waldorf, D. (1981). Snowball Sampling: Problems and Techniques of Chain Referral Sampling. *Sociological Methods & Research*, 10(2), 141-163.

Bishop, A. (1994). Cultural conflicts in mathematics education: developing a research agenda. *For the Learning of Mathematics*, 14(2), 15-18.

Boaler, J. (1993). "The Role of Contexts in the Mathematics Classroom: Do They Make Mathematics More "Real"?" *For the Learning of Mathematics* 13(2): 12-17.

Boaler, J. (2008). *What's Math Got to Do with It?: Helping Children Learn to Love Their Most Hated Subject. And Why It's Important for America*. New York: Viking.

Bottero, W. (2004). Class Identities and the Identity of Class. *Sociology, 38*(5), 985-1003.

Bourdieu, P. (1967). Systems of education and systems of thought. *International Social Science Journal*, 19, 338-358.

Bourdieu, P. (1974). The School as a Conservative Force. In J. Eggleston (Ed.), *Contemporary Research in the Sociology of Education* (pp. 32-46). London: Methuen.

Bourdieu, P. (1977). *Outline of a Theory of Practice.* (R. Nice, Trans.). Cambridge: Cambridge University Press.

Bourdieu, P. (1984). *Distinction : A Social Critique of the Judgement of Taste (R. Nice, Trans.)*. London: Routledge and Kegan Paul.

Bourdieu, P. (1986). The Forms of Capital. In J. G. Richardson (Ed.), *Handbook for Theory and Research for the Sociology of Education* (pp. 241-258). Westport: Greenwood Press.

Bourdieu, P., & Passeron, J.-C. (1990). *Reproduction in Education, Society and Culture*. London: Sage.Brown, M., Brown, P., & Bibby, T. (2008). I would rather die': reasons given by 16-year-olds for not continuing their study of mathematics. *Research in Mathematics Education*, 10(1), 3-18.

Brubacker, R. (1993). Social Theory as Habitus. In E. Lipuma, M. Postone & C. J. Calhoun (Eds.), *Bourdieu: Critical Perspectives* (pp. 212-234). Chicago: University of Chicago Press.

Byrne, B. M. (1984). The General/Academic Self-Concept Nomological Network: A Review of Construct Validation Research. *Review of Educational Research*, 54(3), 427-456.

Coleman, J. S. (1958). Relational Analysis: The Study of Social Organizations with Survey Methods. *Human Organization*, 17(4), 28-36.

Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, 94, S95-S120.

Cooper, B. (1994). Secondary mathematics education in England: recent changes and their historical context. In M. Selinger (Ed.), *Teaching Mathematics* (pp. 5-26). London: Routledge.

Cooper, B. (1998). Assessing National Curriculum Mathematics in England: Exploring Children's Interpretation of Key Stage 2 Tests in Clinical Interviews. *Educational Studies in Mathematics,* 35, 19-49.

Cooper, B., & Dunne, M. (2000). *Assessing Children's Mathematical Knowledge: Social Class, Sex and Problem-Solving*. Maidenhead: Open University Press.

Cooper, B. (2005). Applying Ragin's Crisp and Fuzzy Set QCA to Large Datasets: Social Class and Educational Achievement in the National Child Development Study. *Sociological Research Online, 10*(2).

Cooper, B., & Glaesser, J. (2008). How Has Educational Expansion Changed the Necessary and Sufficient Conditions for Achieving Professional, Managerial and Technical Class Positions in Britain? A Configurational Analysis. *Sociological Research Online*, 13(3), 2.

Cooper, B., & Glaesser, J. (2011). Qualitative Work and the Testing and Development of Theory: Lessons from a Study Combining Cross-Case and Within-Case Analysis via Ragin's QCA. Presented at *European Sociological Association,* 10th conference, Geneva 2011.

Crozier, G. (1999). Is it a case of "We know when we're not wanted?" The parents' perspective on parent-teacher roles and relationships. *Educational Research*, 41(3), 315-328.

Crozier, G. (2000). *Parents and Schools: Partners or Protagonists?* Stoke on Trent: Trentham.

Curtis, P. (2008, 17th September). Too many graduates, not enough jobs, says CBI. *Guardian*, accessed online at: http://www.guardian.co.uk/education/2008/sep/17/graduates.business

D'Ambrosio, U. (1985). Ethnomathematics and its Place in the History and Pedagogy of Mathematics. *For the Learning of Mathematics,* 5(1), 44-48.

Desforges, C. (2003). *The Impact of Parental Involvement, Parental Support and Family Education on Pupil Achievements and Adjustment: A Literature Review*.
Department for Education and Skills [DfES]. (2003). *The Impact of Parental Involvement on Children's Education*. London: HMSO.

Domina, T. (2005). Levelling the Home Advantage: Assessing the Effectiveness of Parental Involvement in Elementary School. *Sociology of Education*, 78, 233-249.

Dowling, P. (1998). *The Sociology of Mathematics Education: Mathematical Myths/Pedagogic Texts*. London: Falmer.

Duncan, J. (2005). Frontal Lobe Function and General Intelligence: Why it Matters. *Cortex*, 41(2), 215-217.

Dunne, M., & Gazely, L. (2008). Teacher, Social Class and Underachievement. *British Journal of Sociology of Education*, 29(5), 451-463.

Elliot, J., Miles, A., Parsons, S., & Savage, M. (2010). The design and content of the 'Social participation' study: A qualitative sub-study conducted as part of the age 50 (2008) sweep of the National Child Development Study. *CLS Working Paper 3*.

Epstein, J. L., & Sanders, M. G. (2000). Connecting home, school and community: new directions for social research. In M. T. Hallinan (Ed.), *Handbook of the Sociology of Education*. New York: Kluwer.

Ernest, P. (1991). *The Philosophy of Mathematics Education*. Basingstoke: Falmer.

Flude, M., & Ahier, J. (1974). *Educability, schools and ideology.* Abingdon, Oxford: Taylor and Francis.

Friedel, J. M., Cortina, K. S., Turner, J. C., & Midgley, C. (2007). Achievement Goals, Efficacy Beliefs and Coping Strategies in Mathematics: The Roles of Perceived Parent and Teacher Goal Emphases. *Contemporary Educational Psychology*, 32, 434-458.

Gammage, P. (1987). Chinese Whispers. *Oxford Review of Education*, 13(1), 95-105.

Gillard, D. (2011). *Education in England: a brief history*. Available at: www.educationengland.org.uk/history

Glaesser, J., & Cooper, B. (2011). Selecting cases for in-depth study from a survey dataset: an application of Ragin's configurational methods. *Methodological Innovations Online*, 6(2), 52-70.

Glaser, B. G., & Holton, J. (2004). Remodeling Grounded Theory. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 5.

Gluckman, M. (1967). *The Judicial Process Among the Barotse of Northern Rhodesia*. Manchester: Manchester University Press.

Goffman, E. (1963). *Stigma: Notes on the Management of Spoiled Social Identity*. New Jersey: Prentice-Hall.

Goldthorpe, J. H. (1987). *Social Mobility and Class Structure in Modern Britain*. Oxford: Clarendon.

Halliday, M. A. K. (1974). Some aspects of sociolinguistics Interactions: Between Linguistics and Mathematics Education: Final Report of the Symposium. Nairobi: UNESCO.

Halsey, A. H., & Sylva, K. (1987). Plowden: history and prospect. *Oxford Review of Education*, 13(1), 3-11.

Halsey, A. H., Heath, A. F., & Ridge, J. M. (1980). *Origins and destinations: family, class, and education in modern Britain*. Oxford: Clarendon.

Hedström, P. & Ylikoski, P. (2010). Causal Mechanisms in the Social Sciences, *Annual Review of Sociology*, 36(1), 49-67.

Hilgers, M. (2009). Habitus, freedom, and reflexivity. *Theory & Psychology*, 18, 404-422.

Hirata, J., Nishimura, K., Urasaka, J., & Yagi, T. (2006). Parents' Educational Background, Subjects "Good-At" in School and Income: An Empirical Study. *The Japanese Economic Review*, 57(5), 533-546.

Hirst, P. H. (1974). *Knowledge and the Curriculum: A Collection of Philosophical Papers*. London: Routledge and Kegan Paul.

Hodgen, J., Kuchemann, D., Brown, M., & Coe, R. (2009). Children's understandings of algebra 30 years on. *Research in Mathematics Education,* 11(2), 193-194.

Horvat, E. M., Weininger, E., & Lareau, A. (2003). From social ties to social capital: Class Differences in the Relations between Schools and Parent Networks. *American Educational Research Journal, 40*(2), 319-351.

Illich, I. (1971). *Deschooling society*. London: Calder and Boyars.

Jenkins, R. (1982). Pierre Bourdieu and the Reproduction of Determinism. *Sociology*, 16(2), 270-281.

Karabel, J., & Halsey, A. H. (1977). Educational Research: A Review and Interpretation. In J. Karabel & A. H. Halsey (Eds.), *Power and Ideology in Education* (pp. 1-92). Oxford: Oxford University Press.

Kluge, S. (2000). Empirically Grounded Construction of Types and Typologies in Qualitative Social Research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 1(1).

Lareau, A. (1987). Social Class Differences in Family-School Relationships: The Importance of Cultural Capital. *Sociology of Education*, 60, 73-85.

Lareau, A. (1989). *Home Advantage: Social Class and Parental Intervention in Elementary Education*. London: Falmer.

Lazarsfeld, P. F. (1937). Some Remarks on the Typological Procedures in Social Research. *Zeitschrift fur Sozialforschung*, VI, 119-139.

Lieberson, S. (2004). Comments on the Use and Utility of QCA. *Qualitative Methods: Newsletter of the American Political Science Association Organized Section on Qualitative Methods*, 2(2), 13-14.

Locke, J. (1996 [1695]). '*Some thoughts concerning education' and 'Of the conduct of the understanding'.* (R. W. Grant & N. Tarcov, Trans.). Indianapolis: Hackett.

Lubienski, S. T. (2000). Problem Solving as a Means toward 'Mathematics for All': An Exploratory Look through a Class Lens. *Journal for Research in Mathematics Education*, 31, 454-482.

Macleod, F. (Ed.). (1989). *Parents and Schools: The Contemporary Challenge* (Vol. 5). London: Falmer.

Mahoney, J., & Goertz, G. (2006). A Tale of Two Cultures: Contrasting Quantitative and Qualitative Research. *Political Analysis*, 14(3), 227-249.

Mannewitz, T. (2011). Two-Level Theories in QCA: A Discussion of Schneider and Wagemann's Two-Step Approach, from http://www.compasss.org/files/WPfiles/Mannewitz2011.pdf, accessed 15th July, 2011.

Marsh, H. W., Byrne, B. M., & Shavelson, R. J. (1988). A multifaceted academic self-concept: Its hierarchical structure and its relation to academic achievement. *Journal of Educational Psychology*, 80(3), 366-380.

Mendel, J. M., & Ragin, C. C. (2011). fsQCA: Dialog Between Jerry M. Mendel and Charles C. Ragin, from http://www.compasss.org/pages/resources/emailmendel.pdf, accessed 4th September, 2011.

Merton, R. K. (1968). *Social Theory and Social Structure* (3rd ed.). New York: Free Press.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: An expanded sourcebook (2nd ed.)*. London: Sage.

Mill, J. S. (1967 [1843]). *A System of Logic*. Toronto: University of Toronto Press.

Mills, C. W. (1940). Situated actions and vocabularies of motive. *American Sociological Review*, *5*(6), 904-913.

Nash, R. (1990). Bourdieu on Education and Social and Cultural Reproduction. *British Journal of Sociology of Education*, 11(4), 431-447.

Nunes, T., Carraher, D. W., & Schliemann, A. D. (1993). *Street mathematics and school mathematics*. Cambridge: Cambridge University Press.

Ojose, B. (2008). Applying Piaget's Theory of Cognitive Development to Mathematics Instruction. *The Mathematics Educator*, 18(1), 26-30.

Phenix, P. H. (1964). *Realms of meaning*. New York: McGraw-Hill.

Piaget, J. (1970). *Science of education and the psychology of the child*. New York: Viking.

Powell, A. B., & Frankenstein, M. (1997). *Ethnomathematics: Challenging Eurocentrism in Mathematics Education*. Albany: SUNY Press.

Prandy, K. (1999). Class, stratification and inequalities in health: a comparison of the Registrar-General's Social Classes and the Cambridge Scale. *Sociology of Health & Illness*, 21(4), 466-484.

Price, M. H. (1994). *Mathematics for the Multitude? A History of the Mathematical Association*. Leicester: The Mathematical Association.

Ragin, C. C. (1987). *The comparative method: moving beyond qualitative and quantitative strategies*. Berkerly: University of California Press.

Ragin, C. (1999). Using Qualitative Comparative Analysis to Study Causal Complexity. *Health Services Research, 34*(5).

Ragin, C. C. (2000). *Fuzzy-set social science*. Chicago: University of Chicago Press.

Ragin, C. C. (2004). Between Complexity and Parsimony: Limited Diversity, Counterfactual Cases, and Comparative Analysis. In S. Kropp & M. Minkenberg (Eds.), *Vergleichen in der Politikwissenschaft*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Ragin, C. C. (2006a). Set Relations in Social Research: Evaluating Their Consistency and Coverage. *Political Analysis*, 14(3), 291-310.

Ragin, C. C. (2006b). The limitations of net-effects thinking. In B. Rihoux & H. Grimm (Eds.), *Innovative Comparative Methods for Political Analysis*. New York: Springer.

Ragin, C., & Rihoux, B. (Eds.). (2009). *Configurational Comparative Methods*. London: Sage.

Rapple, B. A. (1994). Payment by Results. *Educational Policy Analysis Archives*, 2.

Reay, D. (1995). They employ cleaners to do that: habitus in the primary classroom. *British Journal of Sociology of Education*, 16(3), 353-371.

Reay, D. (1998a). *Class Work: Mothers' Involvement in their Children's Primary Schooling*. London: University College Press.

Reay, D. (1998b). Engendering Social Reproduction: mothers in the educational marketplace. *British Journal of Sociology of Education*, 19(2), 195-209.

Reay, D. (2005). Doing the dirty work of social class? Mothers' work in support of their children's schooling. *Sociological Review*, 53(2), 104-115.

Sammons, P., Mortimore, P., & Varlaam, A. (1985). *Socio-Economic Background, Parental Involvement and Attitudes, and Children's Achievements in Junior Schools* London: ILEA Research and Statistics Branch.

Sayer, J. (1989). Facing Issues in Parents' Responsibility for Education. In S. Wolfendale (Ed.), *Parental Involvement: Developing Networks between School, Home and Community* (pp. 120-128). London: Cassell.

Schneider, C. Q., & Wagemann, C. (2006). Reducing complexity in Qualitative Comparative Analysis (QCA): Remote and proximate factors and the consolidation of democracy. *European Journal of Political Research*, 45(5), 751-786.

Schneider, C. Q., & Wagemann, C. (2010). Standards of Good Practice in Qualitative Comparative Analysis. *Comparative Sociology*, 9, 1-22.

Scott, J. (2000). Rational Choice Theory. In G. Browning, A. Halcli & F. Webster (Eds.), *Understanding Contemporary Society: Theories of The Present* (pp. 126-139). London: Sage.

Skaaning, S.-E. (2011). Asessing the Robustness of Crisp-set and Fuzzy-set QCA Results. *Sociological Methods & Research*, 40(2), 391-408.

Sternberg, R., Nokes, C., Geissler, P. W., Prince, R., Okatcha, F., Bundy, D. A., et al. (2001). The relationship between academic and practical intelligence: a case study in Kenya. *Intelligence*, 29(5), 401-418.

Swetz, F., & Kao, T. I. (1977). *Was Pythagoras Chinese? An examination of right triangle theory in ancient China*. Pittsburgh: University of Pennsylvania Press.

Tan, B. Y., & Yates, S. M. (2007). A Rasch analysis of the Academic Self-Concept Questionnaire. *International Education Journal*, 8(2), 470-484.

Tapson, F. (2000). The Language of Mathematics. *International Journal for Mathematics Teaching and Learning*.

Tarcov, N. (1984). *Locke's Education for Liberty*. Chicago: University of Chicago.

Thomson, S. (2011). Exploring when maternal interest is sufficient for high attainment in mathematics: A configurational analysis using longitudinal data. *Methodological Innovations Online, 6*(2), 148-160.

Thomson, S. (in press). The Problem of Limited Diversity in Qualitative Comparative Analysis: A Discussion of Two Proposed Solutions. *International Journal of Multiple Research Approaches, 5(2)*, 254-268.

Tooley, J., & Darby, D. (1998). *Educational Research: a critique*. London: OFSTED.

Vincent, C. (1996). *Parents and Teachers: Power and Participation*. London: Falmer.

Wacquant, L. (2006). Pierre Bourdieu. In R. Stones (Ed.), *Key Contemporary Thinkers*. London: Macmillan.

Walkerdine, V. (1988). *Counting girls out: girls and mathematics* (2nd ed.). London: Falmer.

Weber, M. (1920). Conceptual Exposition. In G. Roth & C. Wittich (Eds.), *Economy and Society* (1968). Berkerley: University of California Press.

Weininger, E. B., & Lareau, A. (2007). Cultural Capital. In G. Ritzer (Ed.), *Encyclopedia of Sociology*. Oxford: Blackwell.

Yolton, J. W. (1985). *Locke: An Introduction*. Oxford Blackwell.

Zevenbergen, R. (2000). "Cracking the Code" of Mathematics Classrooms: School Success as a Function of Linguistic, Social and Cultural Background. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning* (pp. 201-223). Westport: Praeger.